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ABSTRACT

This educational program intends to promote a universal view of the environment through interdisciplinary, activity-centered experiences. The objectives identified are to help students examine environmental relationships, acquire problem-solving skills to analyze society's environmental problems, and develop civil responsibility and values. The guide gives suggestions and procedures for implementing the program. Most of the guide contains environmental investigations for grades K-7 and 8-12. Each investigation lists goals and objectives, key questions, and suggested procedures to answer the key questions. The processes used in the procedures are also listed. The appendix contains an annotated bibliography of environmental education readings. (MR)

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# ENVIRONMENTAL Education Guide K-12

DIVISIONS OF ELEMENTARY, SECONDARY, AND VOCATIONAL EDUCATION
STATE DEPARTMENT OF EDUCATION
RICHMOND, VIRGINIA 23216
JULY 1974

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# ENVIRONMENTAL Education Guide K-12

Divisions of Elementary, Secondary, and Vocational Education
State Department of Education
Richmond, Virginia
July, 1974

# PREFACE

The knowledge, skills, and understandings which relate to our total environment are of significant importance to every citizen. Teachers and school administrators have an obligation and a commitment to inform students about the need for understanding and conserving the environment. Our aim is to teach students of Virginia to love, appreciate, and understand the complexity of interacting forces in our environment and how important these forces will always be to the rich inheritance which we all enjoy.

# ACKNOWLEDGEMENTS

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In addition, some sections of the guide rely on the approach and methods used in the activities produced by the U. S. Forest Service.

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# II. INTRODUCTION

During the past decade Americans gradually learned that there was a new problem for them to deal with as they struggled to achieve the "good life." Writer after writer, in an accelerating progression of reports, painted disturbing, sometimes grim, pictures of a progressively deteriorating environment. So many things that we had taken for granted for so long seemed to be severely threatened. We learned that certain foods were unsafe to eat, some water was unsafe for swimming, and air in some locations was unsafe to breathe. In addition, we found that we were running out of a variety of mineral resources with no hope of replenishing them. We learned that energy production was rapidly being overtaken by demand. Experts told us that we were being irresponsible in allowing our population to increase too rapidly and that only through population control would we solve our problems.

Citizens began to respond to the threat of environmental deterioration in many ways. Among the many responses were: The creation of new governmental agencies (e.g., the Environmental Protection Agency, the Office of Environmental Education of the U.S. Office of Education); new legislation governing the exploitation of the environment; a variety of citizens' groups whose activities were specifically related to environmental issues (e.g., Zero Population Growth, Friends of the Earth); and the increase of environmental emphasis in the activities of agencies which traditionally had been concerned with preservation and management of natural resources (The U. S. Park Service, the U. S. Forest Service, The Sierra Club, the Audubon Society).

As efforts to cope with the "Environmental Menace" proceeded on many fronts, it gradually became evident that, in the long run, man could only live in harmony with his environment if he understood it and used it wisely. Thus, only "environmentally literate" persons should be able to take the responsible action necessary to maintain a quality of life satisfactory to all while managing the limited resources of the environment. The need for programs of environmental education was a result of the greater awareness of the nature of environmental deterioration which began to emerge in the late 1960's and the 70's. President Nixon, in his 1970 Message on Environmental Quality, observed that:

> We must seek nothing less than basic reform in the way our society looks at problems and makes decisions. Our educational system has a key role in bringing about this reform. . . . It is also vital that our entire society develop a new understanding and a new awareness of man's relation to his environment that might be called 'environmental literacy.' This will require the development and teaching of environmental concepts at every point in the educational process.

## B. What Is Environmental Education?

Many attempts have been made to define environmental education. Each has attempted to describe the process of creating "environmentally literate" persons. The definition provided by Sidney Marland, former U. S. Commissioner of Education, is representative:

> Environmental education is intended to promote among citizens the awareness and understanding of the environment, our relationship to it, and the concern and responsible action necessary to insure our survival and to improve the quality of life.

This definition, and others like it, tell us what the desirable outcomes of educational programs should be. They do not, in any way, reveal the means to reach these outcomes.

Educators have had as their principal aim the achievement of rather narrowly-defined objectives asso-

ciated with various skills and areas of knowledge. Never before has it been necessary to introduce programs into the schools for which there were no specifically designated teacher training programs. The concept of "environment" is so broad that new strategies will have to be planned to teach students to understand the many complexities of their environment.

A beginning has been made toward reaching the goal of effective programs of environmental education. In the late 1960's programs called "Environmental Education" began appearing throughout the country. Many emphasized nature study, outdoor education, or urban environment. Others represented rather traditional programs with emphasis on an environmental problem (e.g., pollution). The great diversity of programs obviously came from different concepts of environmental education. It is wise to recognize that we are in a period when the meaning of environmental education still is evolving. Every effort made to develop an environmental education program offers an opportunity to determine what works and what fails. Thus, it is important to identify program objectives carefully and to evaluate the results to determine if the objectives have been met. This is not an easy task, but it is necessary if a widely agreed-upon concept of environmental education is to evolve.

## C. Objectives of a K-12 Environmental Education Program

In developing a program of environmental education for kindergarten through grade 12, it is necessary to establish program objectives. The objectives identified for this guide are:

1. To help the student examine more critically those phenomena and relationships which constitute his environment.
2. To assist the student in acquiring problem-solving and decision-making skills necessary to guide him in living in harmony with the environment.
3. To help the student develop the spirit and skills of inquiry in examining the specific and general environmental implications of human activities.
4. To foster greater understanding of, and concern for, society's environmental problems.
5. To help the student develop a sense of civil responsibility and the awareness that his actions affect others just as the actions of others affect him.
6. To promote the clarification of the values which the student holds and from which all environmental activities and decisions are derived.

## D. Program Characteristics

The K-12 Environmental Education Guide was developed on the assumption that a program which will meet the objectives listed above must:

1. . . . be developed locally. The most accessible and comprehensible environments for children to learn about are those in their immediate vicinity. This is particularly important in the lower grades.
2. . . . be interdisciplinary in nature. Only by having experiences which draw simultaneously from different subject areas (e.g., science, social studies, math) can students begin to appreciate and understand the scope and complexity of environmental phenomena.

3. . . . promote interest in, awareness of, and sensitivity toward the environment. The affective dimension of environmental education programs is crucial in developing concerned citizens.

4. . . . be activity-centered. Environmental experiences should immerse the student in the "real" world which he can see, touch, and smell.

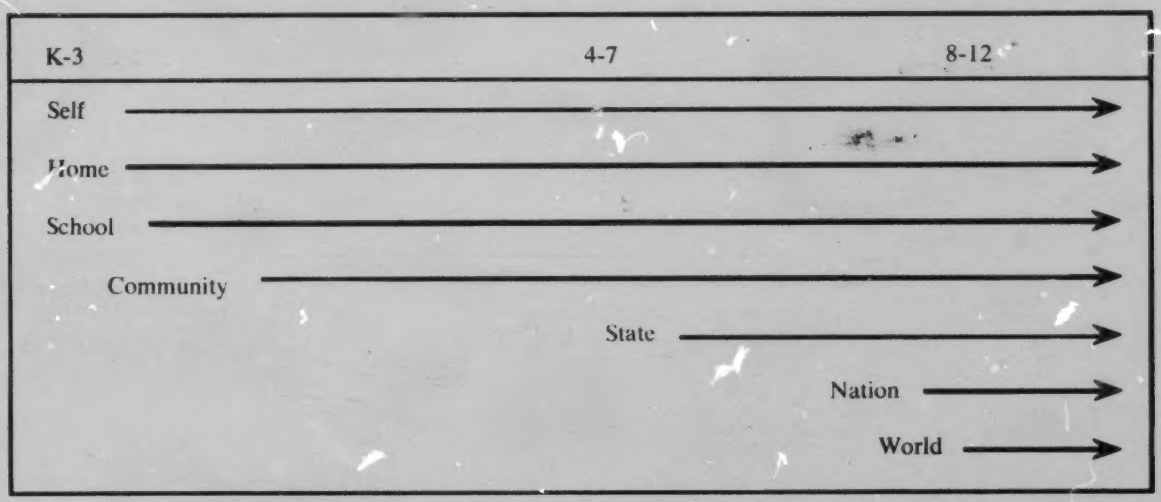
5. . . . be participant-centered. Student participation should be encouraged by allowing the students to help determine the nature of the experiences in which they are involved.

6. . . . have a future orientation. Students must be helped to realize that their actions in the present determine consequences in the future.

7. . . . build toward a universal view of the environment. The "spaceship earth" concept may be the ultimate expression of environmental literacy.

## E. Composition and Organization of the Guide

Having identified the program objectives and characteristics, it was decided that different environmental emphasis at different grades in the K-12 continuum could provide for the interests and capabilities of the students and the accessibility of various environmental settings. That is, self, home, and school would be the logical environments to explore in the early elementary grades. Subsequent student investigations could move out into the locality and later consider the State, nation, and world. These changing emphases are illustrated in the following diagram.




This guide was designed to reflect the program characteristics previously identified and to suggest ways in which these objectives may be met. Because the guide has been conceived in relation to the principle that the most effective programs of environmental education are those which are developed in local school divisions, it is extremely important for teachers to realize that this document is exactly what its title suggests—a guide. It consists of a series of model activities offered as examples to guide teachers in developing local programs. While many teachers will select one or more of the suggested activities to use in their local environments, it is possible that in some local programs none of the suggested activities will be used in the precise form in which they are presented.

The primary activity recommended here is investigation—a process of finding out about something of

concern which is not fully understood. Thus, by definition, an investigation incorporates the means by which many of the objectives of environmental education may be met. To aid teachers in developing investigations of their local environments, the following characteristics of an investigation were identified and used in the development of this guide.

An environmental investigation should:

1. . . . be interdisciplinary, i.e., involve an experience containing elements drawn from two or more disciplines.
2. . . . be activity-centered and process-oriented. It should require the learner to study a particular environment first-hand and promote the practice and application of such processes as:

   a. observing
   b. inferring
   c. communicating
   d. data-collecting
   e. hypothesizing
   f. decision-making
   g. valuing

3. . . . promote the acquisition of knowledge and insight into such environmentally-significant concepts as:

   a. change
   b. interaction
   c. community
   d. resources
   e. energy
   f. patterns
   g. economics
   h. alternatives
   i. civic responsibility
   j. values
   k. equilibrium

4. . . . promote cooperative effort among students, teachers, and other individuals and agencies in the community.
5. . . . provoke value judgement concerning the ways various environmental experiences affect people.
6. . . . lead to the identification of alternative courses of action in dealing with environmental problems.
7. . . . permit the reconciliation of a variety of value-based positions on environmental alternatives through student interactions, exchange of ideas, and debate.
8. . . . culminate in a consensus position of the total group of students regarding the environmental issues to which the investigation relates.

Because of the great diversity of settings, every investigation may not possess all of the above characteristics, however, all investigations should possess most of them.

The model investigations developed in this guide have been broadly divided between those which seem appropriate for elementary students, pupils in kindergarten through grade seven, and those which are suggested for secondary school students in grades eight through twelve. This division is not precise. Those investigations developed for elementary pupils, while generally following the suggested characteristics identified above, tend to deal with aspects of the child's environment which are personal and easily perceived. Also, the tasks recommended for the pupils are less complex and time-consuming than some of those which appear in the secondary school investigations. It is possible, even desirable, for investigations in the secondary section to be modified for use in elementary schools. Conversely, many of the elementary activities may be modified for use by classes in secondary schools.

# F. Using the Guide

**In the Elementary School (K-7)**

When contemplating the introduction of environmental education in the early elementary grades, it is particularly important to acknowledge the special nature of the very young learner. An examination of patterns of changing characteristics quickly reveals that children in the early elementary school grades should not be expected to conduct complex investigations dealing with a number of environmental variables and relationships. However, much can be learned during the early elementary years, particularly if the emphasis is directed at those skills which, in later years, will be necessary to cope with more comprehensive experiences of the type which occur in making investigations. Experiences which help the development of communication skills, esthetic expression, and good human relations will all enhance future environmental activities. Many of the process skills which are featured in the sample investigations can be enhanced by creating experiences for the young child in which discreet elements in his environment become the focus of careful observation. Helping the child to describe his experiences with greater precision and objectivity, teaching him to measure, assisting with classifying objects, and promoting effective communication of his experiences to others are all important processes which can be developed in the early elementary grades. For assistance with the development of specific learning situations which promote process skill development, teachers will find the *State Elementary Science Guide, K-7* particularly helpful. Also, many of the recently published textbook series in both science and social studies have a process orientation and will provide additional suggestions for activities with a process emphasis.

The pattern of changing characteristics of children suggests that by the time children have reached the middle to upper elementary grades they are capable of profiting from comprehensive studies of their environments in the form of investigations. In the sample investigations suggested in this Guide, Investigations One through Eight were written specifically for middle and upper elementary students. Thus, when the teacher judges that her pupils are "ready" to conduct an environmental investigation, these eight models may point the way to the development of experiences in the locality which will interest the children and reveal aspects of their environment formerly unrecognized. Teachers may wish to start by trying one of the sample investigations, adapted where appropriate to the specific environment of the children. Each of the model investigations poses several questions and suggests ways to gather information which will help the students answer them. Ultimately, the best locally-developed investigations will be the ones which proceed from questions raised by pupils. If the pupils have difficulty in formulating the kinds of questions to start them in an investigation of their locality, articles in a local newspaper which relate to environmental concerns of the community or guest speakers from the community may provide a focal point for developing related questions to comprise a meaningful investigation.

Once questions have been raised it becomes the teacher's role to guide the pupils toward an information-gathering procedure. This should help them probe many aspects of their environments which will shed light on the original questions. Throughout, the process orientation of the sample investigations should be built into the locally-developed investigation to assist pupils with learning effective methods for gathering relevant information. Different points of view often will develop regarding the significance of various findings, and pupils will need assistance in making decisions which reconcile these different value-based positions. At all times pupils must be helped to distinguish between facts and opinions, observations and inferences, and universal meaning and personal meaning.

In assisting pupils with gathering relevant information, teachers may feel that their background and training limit their ability to perceive all of the environmental factors relating to the initial questions. It is hoped that the model investigations in this Guide will assist teachers in seeing many of the ramifications possible in environmental investigations. Also, communication with other teachers in the school and frequent discussions of investigations being planned with parents and other residents in the community can reveal possibilities

which might not occur to the individual teacher. Perhaps the most important aspect of the teacher's role in assisting children with environmental investigations is the realization that it is not necessary for the teacher to know answers in advance to pupils' questions. If teachers and pupils adopt a "let's find out" attitude, then the teacher's role is to assist the pupils in using effective investigative processes. It is *not* to supply the answers to pupils' questions.

Some upper elementary and middle schools are organized along departmental lines. In such situations specialists are available to form teams representing different subject areas. Such teams can be very helpful in assisting pupils with planning and conducting environmental investigations. Art and music teachers can help to provide insight into the esthetic aspects of the environment; social studies teachers can contribute historical, social, and political data; science teachers may offer suggestions for studying a variety of natural phenomena; mathematics teachers can assist with the computational tasks; and agriculture teachers can contribute additional useful data. Every community has residents who work for government agencies, industries, and community institutions who can contribute information. Also, members of garden clubs, civic groups, service organizations, and recreational groups can offer much valuable assistance to the schools. Cooperative efforts among pupils, teachers, and members of the community will tend to produce the richest and most rewarding environmental experiences for the children.

**In the Secondary School (8-12)**

By the time most students reach high school age they are capable of rather sophisticated learning experiences. Also, they tend to ask more challenging questions about their environments. Investigations Nine through Seventeen were written with high school students in mind. The combination of older students asking more challenging questions, when brought together with the more specialized teachers of the secondary schools, can insure the development of extremely effective environmental investigations. Much expertise can be brought to bear on the formulation and conduct of environmental investigations if teachers from the various subject matter areas cooperate as advisory teams working with students and members of the community in the development of strategies for seeking answers to student questions about their environments.

Although the first eight investigations in this Guide were written for elementary school pupils, teachers in secondary schools are encouraged to examine these sample investigations to adapt them for use by their students. This may be particularly important initially, since many secondary students are not likely to have had this type of instruction in their earlier schooling.

The study of the national, world, and State environment will involve vicarious experiences. The sample investigations in this Guide are limited to those environmental phenomena which may be experienced directly. Nevertheless, the insight gained from investigations of concrete materials should help students in dealing with abstract environmental investigations. The development of these investigations should follow principles similar to those stated in the section of this Guide entitled "Composition and organization of the Guide". Whenever possible, vicarious experiences should be made more "real" through intelligent use of instructional media, television, newspapers, and guest speakers. The amount of abstract characteristics of such investigations suggests that they should be appropriate to the specific grade levels in junior and senior high school.

**Additional Suggestions**

After teachers have organized environmental investigations and investigations are completed, several other considerations will become evident. Some suggestions follow:

1. Organizing a Data Bank

   During the investigations, much data will be collected that relates to particular investigations. Some will be acquired from local individuals and agencies and others will be found in various publications. To prevent annoying individuals and agencies and to avoid needless repetition of data collecting procedures, it might be helpful to establish a central file to collect and store data related to the local environment. A simple system might consist of file cards with locally-collected pieces of data and/or data-reduction summaries, plus a library of related publications.

2. Organizing an Investigation File

As a source for ideas for investigations and as a means for introducing new teachers to the school's environmental education program, a file of all investigations conducted by students in the school can be very helpful. Records of these investigations should include: teacher(s) name(s); grade level; questions raised; investigatory procedures; summary of findings; teacher comments identifying problems, particularly successful experiences; and suggestions for modifying future related investigations.

3. Library Resources for Environmental Education

Teachers should be alert for useful references to support locally-developed environmental investigations and see that, where possible, they are purchased by the school librarian. Files of newspaper clippings and magazine articles about local environmental issues might be placed in the school library. The list of Readings in Environmental Education (Appendix) in this Guide may provide a starting point for the development of useful library resources for the support of local environmental education programs.

4. Evaluation

The evaluation of diverse continuing learning experiences poses special challenges. It is the mature behavior of students that provides the true measure of success of environmental education programs. Nevertheless, there are means for inferring the effectiveness of environmental education activities within a school program. Teachers should attempt to answer such questions as the following to determine the effectiveness of the program:

a. After completing an investigation, do the students ask better questions in commencing subsequent investigations?
b. Do students use their resources more effectively in developing new investigations?
c. In discussing different value-based reactions to their environments, do students show more tolerance of other points of view?
d. Is there any evidence that students have tried to help their parents exhibit performance characteristics of greater environmental awareness?
e. Does the behavior of students within the school appear to reflect the influence of their environmental investigations?

# III. ENVIRONMENTAL INVESTIGATIONS (K-7)

Environmental education transcends all subject areas of the elementary school curriculum. Traditionally, environmental education has been a small part of elementary school science. Yet, environmental education crosses all curricular areas. The previously mentioned trends include discovery and inquiry as well as concept development. Such trends also are found in other areas of the curriculum, especially social studies. Thus, it becomes increasingly less complex to unify environmental education through all instructional areas of the curricula.

The following are suggestions that may be used to develop a viable environmental education program in the elementary school:

1. Through brainstorming sessions the faculty can determine, in part, concepts to be developed in the environmental education program. Such concepts should include local environmental problems (e.g. lack of a sewage disposal system, strip-mining areas, and location of zoning variances).
2. A chairman should be selected to coordinate all such attempts and to aid the faculty in organizing a program. Some released time away from teaching duties may be necessary.
3. Local aids and materials must be used fully. Therefore, it is imperative that a collection of such materials be made, using a 3 × 5 card file or some other means. Local newspaper editors, mining company personnel, city government officials, agriculture leaders, and others in the locality should be used as resource persons to aid the classroom teacher in the environmental education program.
4. It is important that teachers who represent all grade levels be used and that they are encouraged to contribute to group efforts.
5. Monies, logistical planning, and time away from the school grounds for environmental studies should be a part of the program, especially in elementary school.
6. Careful consideration should be given to the broad range of each student's interests, needs, and abilities in incorporating environmental education into the curriculum. Investigation activities must be different for each student.
7. It is important to correlate environmental education with the subject areas of the curriculum (e.g., science, social studies, writing, reading, spelling, art, music, mathematics, and physical education).
8. Opportunities should be provided to use the school grounds as an outdoor laboratory to investigate environmental education concepts. Through school and community efforts some elementary schools have developed outdoor laboratories which have become a viable part of the school curriculum.
9. The school librarian should be part of the total teaching effort.

## B. Characteristics of Children and Their Implications for Environmental Education

During the eight years a child spends in elementary school (Grades K-7), dramatic changes occur in his cognitive abilities, communication skills, motor development, social skills, and moral reasoning. Thus, a child in the upper elementary grades is very different from a child in the middle elementary grades who, in turn, is different from a child in the lower elementary grades. These changes in children occur at different rates in

different children and in a more or less continuous fashion. In the preparation of this guide, it was felt that a successful environmental education program must reflect these differences.

For guidance in selecting appropriate activities, the teacher is referred to the following tables in which some generalization about children in the lower, middle, and upper elementary grades are identified with their implications for the environmental education program.

| Children in the *lower* elementary grades: | Implications for environmental education: |
|---|---|
| 1. . . . are curious and employ all their senses in exploring their surroundings. | 1. Activities should promote touching, hearing, seeing, and smelling as ways for gathering information about their environments. |
| 2. . . . bring to school a wide variety of cognitive abilities. | 2. Activities should be developed which offer children of differing cognitive abilities the opportunity to participate and succeed. |
| 3. . . . are limited in their ability to interpret time, space, and distance. | 3. Activities should minimize time, space, and distance aspects of the environment. |
| 4. . . . have difficulty in realizing that objects have several properties. | 4. Activities should emphasize objects with a relatively small number of properties. |
| 5. . . . have difficulty thinking logically. | 5. Activities requiring logical development of relationships should be minimized, particularly in the early grades. |
| 6. . . . begin reasoning simple cause and effect relationships. | 6. Activities should promote the examination of simple cause and effect relationships in the environment. |
| 7. . . . like immediate results and lose interest in prolonged experiences. | 7. Activities should be varied, brief, and scaled to the attention span of the children. |
| 8. . . . seek out identification and clarification of their individual roles as people. | 8. Activities should include experiences aimed at answering the question, "Who am I?" in relation to their environment. |
| 9. . . . are limited in the complexity and variety of their communication skills. | 9. Activities should assist children in expanding and strengthening their use of verbal and nonverbal communication skills. |
| 10. . . . are capable of recognizing the mood of a speaker as factual, serious, or humorous. | 10. This suggests the importance of the teacher's interest, sincerity, and concern while speaking with the children about the environment. |
| 11. . . . enjoy pictures and read their own experience into them as they talk about what they see. | 11. Careful selection of pictures by the teacher can promote interest in the environment and foster the consideration of simple relationships. |
| 12. . . . enjoy using various art forms and media as means of expressing their ideas and feelings. | 12. The children's use of art forms and media can provide valuable information concerning the children's knowledge of, and attitudes toward, their environment. |
| 13. . . . enjoy sharing their experiences with others in their class. | 13. Discussion and guided questioning by the teacher may promote understanding of environmental phenomena as they relate to the children's experience. |

| | |
|---|---|
| 14. . . . enjoy listening to stories read to them. | 14. By carefully selecting stories to be read, teachers can help children become interested in various aspects of their environment. |
| 15. . . . enjoy collecting objects from nature and technology. | 15. Interests revealed by the children's collections may serve as a focus for planned environmental experiences. |
| 16. . . . have limited psychomotor coordination, dexterity, and stamina. | 16. Activities should be selected which do not make unrealistic demands on the children's psychomotor capabilities and endurance. |
| 17. . . . possess a rudimentary moral sense based on highly personal concepts of right and wrong. | 17. Activities should be chosen which avoid complex value dilemmas related to externally-based moral systems. |
| Children in the *middle* elementary grades begin to: | Implications for environmental education: |
| 1. . . . have difficulty initially in isolating variables and often proceed from step to step in thinking without relating each link to all others. | 1. Early in this period, activities should involve small numbers of variables and minimal emphasis on logical relationships. |
| 2. . . . distinguish between observations and inferences. | 2. Activities should promote the distinction between observing and inferring and the logical basis for the process of inferring. |
| 3. . . . distinguish between fact and opinion. | 3. Activities should promote the distinction between fact and opinion and their relative worth as a basis for decision-making. |
| 4. . . . develop special interests and hobbies. | 4. Activities should offer children the opportunity to pursue their individual interests. |
| 5. . . . understand the relationship between cause and effect. | 5. Activities should present situations in which cause-effect relationships may be examined. |
| 6. . . . have increased and refined psychomotor skills. | 6. Activities may be developed which require increased psychomotor coordination. |
| 7. . . . show increasing concern for the authenticity of materials which they read. | 7. With the teacher's assistance, children may be helped to question the authenticity of readings about the environment. |
| 8. . . . detect more subtle forms of a speaker's intent: informative, persuasive, evasive | 8. The degree of interest, enthusiasm, and commitment which the teacher possesses in relation to environmental issues becomes increasingly evident to the children. |
| 9. . . . become increasingly involved as a personal commitment is made. | 9. Activities should stress an action orientation that will result in a stronger commitment to the improvement of the children's environment. |
| 10. . . . become more capable and desirous of involvement in making decisions. | 10. Activities should involve children in making decisions about themselves and their environment. |

| | |
|---|---|
| 11. . . . function as part of a group and begin to understand social requirements and social responsibility. | 11. Activities should foster group experiences and promote the idea that the actions of individuals affect groups and that the individual has a responsibility to the group. |
| 12. . . . relate vicariously to people and places through literature. | 12. Learning about other environments through use of carefully selected literature may help children examine their own environments more critically. |
| 13. . . . develop moral reasoning based on viewing life from other points of view than their own. | 13. Activities can provide opportunities for making moral decisions on a basis rather than what is right or wrong for one as an individual. |
| Children in the *upper* elementary grades begin to: | Implications for environmental education: |
| 1. . . . handle two or more variables with ease and comprehend logical relationships. | 1. Activities may deal with several variables and promote the search for logical relationships. |
| 2. . . . make predictions based on past experiences. | 2. Activities may be developed which emphasize predicting. |
| 3. . . . develop the capability to hypothesize and develop simple tests of hypotheses. | 3. Activities should promote the formulation of hypotheses based on data and the development of means for testing them. |
| 4. . . . develop the ability to discriminate, clarify, and challenge experiences. | 4. Activities should promote the identification of significant factors in a complex environmental setting and promote the clarification of environmental issues. |
| 5. . . . see discussion as a way of working toward group decisions and the resolution of issues. | 5. Activities may be developed around more complex issues to be resolved through group processes. |
| 6. . . . become capable of understanding decision-making processes and the resulting implications of making decisions. | 6. Activities should provide opportunities for children to make decisions and be responsible for the resulting consequences. |
| 7. . . . need the opportunity to assume responsibility in order to learn the relationship between choice and responsibility. | 7. Activities should promote choice and decision-making in a context of responsible action. |
| 8. . . . feel an emotional attachment toward their country and begin developing enduring patriotism. | 8. Activities may be developed to encourage feelings of responsibility by the individual toward the betterment of his country. |
| 9. . . . examine and question established belief systems. | 9. Activities may be developed which raise questions about belief systems and allow the examination of the foundational beliefs on which such systems are based. |
| 10. . . . comprehend moral reasoning based on what is best for society, the greatest number, or the social order. | 10. Activities may be developed which promote more complex moral judgments about environmental issues. |

# C. Exemplary Investigation (K-7)

## INVESTIGATION ONE: HUMAN RELATIONSHIPS

**Goals and Objectives**

The goal of this investigation is to help students understand humans as living things sharing many of the characteristics of other living things but also possessing unique characteristics. During the investigation, students will:

1. Distinguish living from non-living things on the basis of their characteristics.
2. Classify living and non-living things on the basis of a variety of criteria.
3. Distinguish humans from other organisms in terms of physical, social, and emotional characteristics.
4. Identify the nature and role of parental care in rearing young animals, including humans.
5. Clarify the values they employ in making judgments about various human traits.
6. Determine ways by which people may acquire those characteristics one may consider desirable and relinquish those one may consider undesirable.
7. Examine ways to develop concern for other people.
8. Assist others in solving problems.
9. Determine ways in which people interact with each other and their environments.

**Questions:**

A. What are some characteristics of living and non-living objects and how are they classified?
B. What similarities and differences are found between human beings and other living organisms?
C. What characteristics should all humans have?
D. How can we help people to be more concerned about other people?
E. What relationships exist among people and their environments?

**Conducting the Investigation**

A. *Question*

What are some of the characteristics of living and non-living objects and how are they classified?

| *Processes* | *Suggested Procedure* |
|---|---|
| Classifying | 1. Ask the children to identify objects in their classroom as living or non-living. Try to have many of both types of objects in the room. If you have a limited number of living objects in the room, have students make observation outside of the school building. |
| Classifying<br>Inferring<br>Comparing<br>Decision-making | 2. From the lists of living and non-living objects identified above, have the children look for similarities and differences in order to develop a set of characteristics unique to each group. Also, determine which characteristics are common to each group. |
| Classifying | 3. Have the children group different sets of non-living objects. For example:<br>a. collections of rocks, sticks, paper clips, buttons<br>b. cuisenaire rods<br>c. objects found in the classroom<br>d. objects in the surrounding school environment such as:<br>(1) dead trees<br>(2) houses<br>(3) cars<br>(4) TV antennas<br>(5) smokestacks<br>(6) bicycles |

| | |
|---|---|
| Classifying<br>Decision-making | 4. Have the children draw a set of living organism cards (one organism per card) or use pictures cut from magazines.<br>a. In small groups, have the children classify these pictures into groups (sets) and determine the criteria used by other groups.<br>b. Have the children suggest criteria for new groupings. |
| Classifying<br>Decision-making | 5. Have the children form groups from among their classmates.<br>a. Let them decide the basis for each group.<br>b. Have them form different groups on the basis of a new set of criteria.<br>c. Is one method of grouping superior to all others? |

B. *Question*

What similarities and differences are found between human beings and other living organisms?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing<br>Data-collecting | 1. Develop a list of similarities and differences between human beings and other living organisms in relation to:<br>a. physical characteristics<br>b. social characteristics<br>c. emotional characteristics |
| Data-collecting<br>Inferring<br>Observing | 2. Study the habits of some organisms that have similar social patterns to man (bees, ants, baboons). Set up an ant farm or visit a bee hive and record observations about their activities. Use sufficient safety precautions.<br>a. What similarities do you find?<br>b. What differences do you find? |
| Data-collecting<br>Hypothesizing | 3. Examine patterns of rearing the young displayed by human and non-human organisms.<br>a. Compare the length of time of adult control over their young between human and non-human animals.<br>b. How can you account for the great length of time children are supervised by adults? |
| Decision-making | c. How do children feel about this control by parents? Ask the children to make a list of those things they should be able to decide and those their parents should decide for them. (This could be done in small groups and then combined to form a class list.) |

C. *Question*

What characteristics should all humans have?

| *Processes* | *Suggested Procedure* |
|---|---|
| Valuing<br>Communicating<br>Decision-making | 1. As a class project or in small groups, have students prepare lists of human traits they consider desirable. |
| Inferring<br>Communicating<br>Decision-making | 2. Within small groups develop lists of human traits that are characteristics of humans concerned with the environment. |
| Inferring<br>Valuing<br>Decision-making | 3. Give each child the chance to list any three items that he or she wanted to buy but had not been able to afford. Auction the items off to the whole class. |
| Inferring<br>Valuing | 4. Ask each child to determine his best and worst habits. Ask each of them to add two good habits and drop two bad habits from his life. |

| | |
|---|---|
| Inferring<br>Valuing<br>Decision-making | 5. Make a list of personal strengths you think you would like to have. Make a matching list of strengths you feel you already have. Set up a scheme by which someone will teach you a strength that you would like to have. |

D. *Question*

How can we help people to be more concerned about other people?

| *Processes* | *Suggested Procedure* |
|---|---|
| Communicating<br>Decision-making | 1. Using the list of desirable human traits compiled earlier, develop means (e.g., skits, posters, school activities) for encouraging other children in the school to practice these "good" traits. (It is important that the children decide on the methods to be used.) |
| Communicating<br>Decision-making<br>Inferring<br>Hypothesizing | 2. Using the methods found to be successful in D-1, relate efforts to improving human behavior towards the environment. Extend these activities beyond the school environment. Develop ways of influencing the behavior of local residents. |
| Decision-making | 3. Have each child do something nice for someone in the school but keep it a secret. After they have done this, have them make a personal list of their feelings. Ask them if they found out anything about being human? |
| Decision-making | 4. Choose a person in your community such as a teacher, policeman, student, or principal. Find out what their most serious problems are and try to work out a way they could solve these problems. (This can be done as a class or as individuals.) |
| Communicating | 5. With parental approval, talk someone in the community into letting you work with them long enough for you to learn and help each other. (This could be a logical way to integrate career education as part of the environment education curriculum. Children working with foresters, land use planners, and other environmentally oriented careers could do much to expand the ideas of all concerned.) |

E. *Question*

What relationships exist among people and their environments?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing<br>Inferring<br>Hypothesizing | 1. When people are in differing environments do they relate to other people in varying ways? (As an example, do people on a morning commuter bus react differently to strangers than they would to strangers at a sporting event?) |
| Comparing<br>Hypothesizing | 2. Visit a shopping "mall," observe the people and compare them with people shopping on the main street of your community. Did the architects have something in mind (reaction of people to the environment) when they designed the "mall" shopping center? |
| Inferring<br>Hypothesizing | 3. Have students attempt to explain why people continually discard trash on roadsides despite "NO Dumping" signs? |

## INVESTIGATION TWO: THE CLASSROOM ENVIRONMENT

**Goals and Objectives**

The goals of this investigation are to help students view their classrooms as an environment in which they interact with each other and with other factors. In addition, relationships between the classroom environment and the students' community are explored. During the investigation students will:

1. Measure various physical properties of the classrooms and determine how pupils are affected by them.
2. Examine relationships between physical properties of the school environment and those of the classroom.
3. Determine some of the consequences of eliminating one or more of the identified classroom resources for a day.
4. Consider ways various classroom resources might be used more efficiently.
5. Examine physical properties of rooms in the students' homes in a manner similar to that employed in studying their classroom.
6. Consider ways in which all the members of a class can deal with a change in the classroom proposed by an individual student.
7. Examine the rules which govern behavior in the classroom, why they exist and where they originate.
8. Determine the consequences of existing in the classroom for a day in the absence of all rules.
9. Examine rules which might be created to lead to improved environmental conditions.
10. Consider the extent to which all people abide by rules.
11. Attempt to determine what rules (laws) already exist in the community to regulate the environment.
12. Examine rules which seem to regulate people's behavior but are not part of a body of law.
13. Consider the means by which the need for additional laws is determined.
14. Examine the basis employed in the development of new laws for the community.

**Questions:**

A. What are the characteristics of your classroom?
B. In what ways is your classroom similar or different to your room at home?
C. What rules govern your activities while in the classroom?
D. What rules do people live by in your community?

**Conducting the Investigation**

A. *Question*

What are the characteristics of your classroom?

| *Processes* | *Suggested Procedure* |
|---|---|
| Data-collecting | 1. Using classroom material and metric measurements (paper, rulers, thermometers) determine as many of the physical characteristics (e.g., temperature, volume, area) of your room as you can.<br>For example:<br>a. How much floor space is there in the room?<br>b. Determine the area per child and compare that to the area per child in a home, bus, car, or playground.<br>c. What is the average daily temperature in the room?<br>1. Is it the same near the floor?<br>2. Is it the same near the ceiling?<br>3. Is it the same near the window? |
| Inferring<br>Hypothesizing | d. How do you account for your findings? Do all rooms in your school show similar temperature findings? Why or why not? Does the surrounding school environment affect the temperature within your room? How can you find out? |

| | |
|---|---|
| Data-collecting | 2. What kind of furniture is in your room?<br>a. Do you have individual desks or tables?<br>b. Are the desks or tables kept in a pattern?<br>c. What kind of flooring do you have?<br>d. Do you have bookcases and how are they arranged?<br>e. Are there water and toilet facilities in your room?<br>f. What kind of and how many lighting fixtures do you have? |
| Hypothesizing<br>Decision-making | 3. After having completed a listing of your classroom resources, eliminate the use of each for one day (e.g., no use of desk for a day). What effect does this have on your classroom? Can you continue your normal school (life) style? |
| Data-collecting | 4. How can you find out the amount of paper your class uses every day? Every week? Every month?<br>a. Where does paper come from?<br>b. How much does it cost? What other things will the cost of 25 sheets of paper buy? |
| Data-collecting<br>Hypothesizing | c. Examine the paper thrown away after one school day. How much of it still was usable? What are some ways that your class could decrease the use of paper without affecting the instructional program? |
| Inferring | d. Once paper is used what happens to it? Where does it go? Can it be re-used? Would it be possible for your school to save its paper and take it to a recycling plant? With the money received for the paper, could you find ways of improving the environment of your schools' classroom? |
| Data-collecting<br>Hypothesizing<br>Decision-making | 5. Find out the same things about energy (light, heat, etc.), water, and human resources in the classroom as you did with paper in Step 4. |
| Inferring<br>Communicating<br>Valuing | 6. Do any of your findings in Steps 4 and 5 relate to the use of energy and materials in your community? How and why would you make people in the community aware of your investigations? |

B. *Question*

In what ways is your classroom similar or different from a room in your home?

| *Processes* | *Suggested Procedure* |
|---|---|
| Data-collecting | 1. As you did for your classroom, obtain the physical characteristics (i.e., amount of floor space, volume, temperatures, and kinds of furniture) of a room in your home (e.g., bed-room, kitchen, living room, or family room). |
| Data-collecting<br>Inferring | 2. Make a list of these characteristics on the chalkboard. After your classmates have provided information about their rooms, compare the difference and similarities of all the rooms, including your classroom. Are there similarities between rooms in your homes and your classroom? |
| Decision-making | 3. Are there things about your rooms at home that you would like to see in your classroom (e.g., rug, curtains, and rocking chair)? |
| Valuing<br>Decision-making | 4. Are there things in the classroom you would like to see removed? What if some of your classmates do not want it removed? How can you decide with such a disagreement? |

C. *Question*

What rules govern your activities while in the classroom?

| *Processes* | |
|---|---|
| Data-collecting | 1. Why do we have rules in our classroom? Do we need them? Could we get along with no rules? Do some of us need rules more than others? Prepare a list of the rules of your classroom and then do the following: |
| Decision-making<br>Valuing | a. Suspend all classroom rules for a day. At the end of the day, make a list of the good and bad results. |
| Valuing<br>Decision-making | b. Identify the rules you think would be absolutely essential in your classroom. How can you decide which rules to adopt? Does everyone have to agree to the same set of rules? What happens if someone decides that they do not want to follow the rules? |
| Decision-making<br>Valuing | c. Prepare a list of student-developed classroom rules and live by them for several days.<br>(1) Do you need to eliminate some of them?<br>(2) Do you have to add or modify some rules?<br>(3) How will you change your classroom rules in the future? |
| Decision-making | d. What rules can the class agree upon to overcome any problems discovered when you surveyed the classroom environment in Part a? |
| Valuing<br>Decision-making | e. As you set up a system of environmental rules for your classroom, do you need to consider the rules of the school, your principal, your teacher, or your parents? |
| | f. Is it fair if your class has a different set of rules than those used in other classrooms? |
| | 2. Make a list of rules that you think would improve the environment if people followed them. |
| Decision-making | a. Would all people follow these rules? How can you find out (e.g., opinion poll, questionnaire? |
| Inferring | b. If you told people that they had to obey these rules, would they? Did you and your classmates obey all of the rules in your classroom? |
| Data-collecting | c. Does your community already have laws which influence the environment (e.g., zoning regulations, anti-litter laws)? Are they effective? |
| Data-collecting | d. Were these laws passed because people were concerned about environmental deterioration? If not, for what other reason were they passed? |
| Valuing | e. Could you have laws passed in your community to require people to live by your rules? Who would pass these laws and how would they be enforced? Can we improve our environment by telling people exactly what they have to do? |

D. *Question*

What rules do people live by in your community?

| *Processes* | *Suggested Procedure* |
|---|---|
| Data-collecting<br>Valuing | 1. Prepare a list of the rules (laws) which affect the activities of people in your community and determine where these rules are decided upon and by whom (i.e., the community, State agencies, federal agencies). Are any of these sources of rules more important than any others? Why? |

Data-collecting

2. Who decides on the rules followed by a community? Are these rules ever changed? How?

Inferring
Valuing

3. Are there rules a community follows that are not established by a specific governmental body (e.g., not making loud noises late at night)? Why are these rules followed when there is no means of enforcement? Are rules which are

Valuing

adopted unofficially by a community more important or adhered to more often than the "official" rules of the community?

Data-collecting
Valuing

4. What laws has your community adopted that are related to improving the environment? How were these laws adopted? Were they supported by everyone in the community? Is it fair to enforce laws with which not everyone agrees? Do these laws have any economic effects on the community? Were some of these laws adopted to prevent deterioration of the environment at present? To eliminate future deterioration?

Data-collecting

5. What State and federal laws and regulations have been passed which affect your community's environment? Is it fair to have laws that affect you and

Valuing

your community enforced by State and federal officials? When these laws were passed, did your community have a voice in the decision? Is it important whether you participated in making these laws?

Data-collecting

6. Are there local, State, and federal laws being considered which deal with environmental problems? What groups of people are supporting or opposing

Decision-making

these laws? How can students influence decisions about adopting new environmental laws?

7. Frequently decisions, including those which relate to the quality of the environment, are made on an emotional basis without due regard to accurate and unbiased information. Choose a current environmental problem in your community and examine the information which will serve as a basis for decision-making. Consider the following in determining how decisions might be made:

Valuing

a. Who collected the data related to the problem? Do they have a vested interest which will profit by the decision?

Valuing

b. Who analyzed the information? Was the analysis unbiased?

Data-collecting

c. Were a variety of viewpoints considered in the decision-making process?

Data-collecting

d. Were impact studies, projecting the consequences of alternative decisions, made prior to the final decision?

## INVESTIGATION THREE: THE SCHOOL ENVIRONMENT

### Goals and Objectives

The goals of this investigation are to help the students examine more closely their school environment, identify the natural, man-made, and cultural aspects of it, and use it as a model to better understand their community environment. During the investigation, the student will:

1. Identify the natural and man-made objects in the school environment.
2. Indicate the extent to which they value different aspects of the school environment.
3. Express emotional and aesthetic reactions to the school environment through several art forms.
4. Conduct a study of one aspect of the school environment.
5. Collect data which will illustrate changes in the school environment.
6. Determine the extent to which changes in one aspect of the school environment are associated with other changes.
7. Study the relationship between structure and function on the school environment.
8. Make observations of the environment in the area adjacent to the school.
9. Identify similarities and differences between the school and community environments.

10. Evaluate the observations made of the community environment in terms of personal affectivity.
11. Determine the means by which human activities are regulated by law in the community environment.
12. Communicate through written expression the concept of an ideal community.
13. Determine ways to change the school environment.
14. Determine ways to change the community environment.

**Questions:**

A. What are some characteristics of the immediate environment outside the school?
B. How are the conditions around the school similar or different from the surrounding community?
C. Can students influence decisions relating to the school and community environment?

**Conducting the Investigation**

A. *Question*

What are some characteristics of the immediate environment outside the school?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing | 1. Have the children walk around the school grounds and observe carefully the natural and man-made objects in the environment. Have them list their observations and then classify them in terms of: |
| Classifying<br>Valuing | a. objects they like<br>b. objects they dislike<br>c. objects which seem essential<br>d. objects which seem unnecessary<br>e. objects which they would change or remove if they could<br>f. objects, not now present in the school environment, they would add if they could |
| | 2. Collect "junk" material from the school environment and use it to create a work of art (mobile or collage). Try to have your art work express: |
| Communicating<br>Valuing | a. the job of the school environment<br>b. the ugliness of the school environment<br>c. the beauty of the school environment<br>d. how you feel about the school environment. |
| Observing<br>Data-collecting | 3. Choose one aspect of the school environment and make a study of it. For example: |
| | a. Shapes in the environment (a camera might be helpful)<br>b. sounds in the environment (a portable tape recorder might be helpful)<br>c. smells in the environment<br>d. rules that govern the use of the environment<br>e. people in the environment (a camera might be helpful) |
| | 4. When you have completed your study, report your findings to the class, discuss them, and seek answers to the following: |
| | a. Did the class help you identify examples of your subject which you overlooked?<br>b. Were you able to show the class some things about their environment which were a surprise to them? |

Observing
Data-collecting

5. Study your school environment carefully everyday for a week. At the end of the week, discuss with the class any changes in the environment which you observed. For example:
   a. Were there changes in bushes, trees, or lawn areas?
   b. Were there changes in the amount or distribution of litter on the school grounds?
   c. Were there changes in the wetness or dryness of the soil?
   d. Were there changes in the temperature of the air or of the soil?
   e. Did the size of the school grounds change?
   f. Were there changes in the number of cars or bicycles in the school parking lot?
   g. Were there changes in the number of students at various locations on the schoolgrounds?

Observing
Inferring

6. When sharing your findings about changes in the school environment, did you find any instances where change in one situation was associated with change in another? For example:
   a. change in weather and change in the number of students playing on school grounds
   b. change in weather and change in the number of students who ride bicycles to school
   c. change in amount of sunlight available and change in number of students playing on school grounds
   d. change in time of day and change in the number of students playing on school grounds

Observing

7. Make a simple map of the school grounds. Show locations of buildings, roads, parking areas, playing fields, trees, shrubs, and lawns. Then:
   a. Study the flow of traffic (people and vehicles) around the school grounds and plot the areas of maximum traffic activity on your map.
   b. Determine how various parts of the school environment are designed to cope with particularly heavy traffic.
   c. Identify these areas which have heavy traffic but are not specifically designed for it.

B. *Question*

How are conditions around the school similar or different from the surrounding community?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing<br>Data-collecting | 1. Have class walk through a part of the community near your school. Have students identify as many features of the community environment as they can. For example:<br>a. paved streets<br>b. street lights<br>c. lawns<br>d. trees and bushes<br>e. buildings<br>f. fences<br>g. traffic<br>h. people |

2. Have students:

   a. Identify items in their list which may be found in the school environment and those which may not be found in the school environment.
   b. Determine if learning about the school environment will help them learn about their community.

Valuing

3. Have students identify the things they liked and disliked on their walk through the community. Have them suggest ways to change the things they don't like.

Data-collecting

4. Have students determine if there are rules which regulate the community environment. For example, laws regulating:

   a. speed limits
   b. noise levels
   c. the use of land (zoning laws)
   d. burning
   e. water use

5. Have students seek answers to the following: Do you agree with these laws, are laws needed which do not exist, and can you influence which laws are created?

Communicating

6. Have students write a story describing the ideal community—one which would have all the things you like and none of the things you dislike.

C. *Question*

Can students influence decisions relating to the school and community environments?

| *Processes* | *Suggested Procedure* |
|---|---|
| | 1. Identify something (an object, a rule, a condition) in your school environment which you believe many students dislike. Have students do the following: |
| Data-collecting | a. Determine the percentage of students and teachers who also dislike the same thing. |
| Predicting | b. If the answer to part a. is a small percentage, what do you think the chances are that some change can occur when most students and teachers do not share your dislike? |
| Data-collecting | c. If the answer to part a. is a large percentage, collect detailed evidence which will indicate the precise nature of the object of your dislike. Determine if it is harmful (Have any students been hurt by it?), offensive to the eye (Why?), offensive to the nose (What causes the smell?). |
| Data-collecting | d. Determine ways the object of your dislike might be changed. Consider various alternatives and rank them in terms of cost, time required, special equipment, or skills required. |
| Predicting | e. Develop arguments to support the alternatives you have identified. How will the environment be improved by these recommendations? |
| Communicating | f. Prepare a presentation in which you clearly display the nature of your complaint and the evidence to support your arguments for changing it and present your list of alternatives in a clear, concise way. (Photographs, graphs, and taped interviews with students and teachers may help your presentation.) |
| Communicating | g. Have your class make the presentation to the principal. Make it clear that you understand his need to study your materials and consider the alternatives. Try to negotiate a time in the near future when he will respond to your request. |

Inferring

h. If your request was turned down, what reasons were offered in support of the decision? How would you change your method of preparing your presentation if you were to repeat it?

Observing

i. If your request was accepted, did the principal encourage you to make similar presentations in the future?

2. Have students consider the methods used in seeking a change in the school environment and the implications of these methods in seeking a change in the community to determine the following:

Predicting

a. How would you enlist the aid of parents and other adults?

b. What difficulties would you encounter in collecting data about problems in the community environment which you did not encounter in the school environment problem?

Communicating

c. What role can community newspapers play in attempts to bring about changes in the community?

Data-collecting

d. Where would you look for scientifically accurate data to support efforts to bring about change in the community environment?

## INVESTIGATION FOUR: GROWTH

**Goals and Objectives**

The goals of this investigation are to have students examine the phenomenon of growth in a variety of settings, determine some of the factors which influence growth, and consider the consequences of unrestricted growth, particularly as it affects people. During this investigation, students will:

1. Examine different instances of growth and establish criteria which can be used to establish the occurrence of growth.
2. Determine the pattern of their own individual growth.
3. Observe, measure, and record growth of both living and non-living things.
4. Collect data on the growth of plants under various conditions.
5. Evaluate the different growth patterns observed when plants are grown under various conditions.
6. Test hypotheses concerning the factors which influence successful plant growth.
7. Examine evidence of successful growth of particular species of plants in different locations on the school grounds.
8. Collect evidence related to the growth of their school and its consequences.
9. Predict consequences of future growth of the school on the students, teachers, etc. in the school.
10. Collect evidence related to the growth of their community and the consequences of that growth.
11. Predict the consequences of future growth of the community.
12. Relate community growth to economic factors which influence activities in the community.
13. Make judgments about the effects of community growth and the attitudes of residents toward this growth.
14. Examine the consequences of crowding on plant growth in the classroom and in the field.
15. Determine indicators useful in detecting community growth and interactions.
16. Examine the future consequences of current changes in the community.

**Questions:**

A. What is growth and why does it occur?
B. What contributes to and limits growth?
C. What are some consequences of unrestricted growth?

**Conducting the Investigation**

A. *Question*

What is growth and why does it occur?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing<br>Data-collecting<br>Classifying | 1. Starting within the school, have the children identify as many things as possible that are growing. Determine criteria to be used to identify growth. For example:<br>a. increase in size<br>b. increase in mass<br>c. increase in volume |
| Observing<br>Data-collecting<br>Classifying | 2. Repeat investigative strategy #1 but identify evidence of growth in the surrounding school environment and community. Identify both living and non-living examples of growth. |
| Communication | 3. Have the students attempt to define growth either in a statement or a list of criteria. |
| Valuing<br>Decision-making | 4. Using cut-out pictures, have the children make posters illustrating growth. Have them cluster together those pictures of growth they like and examples of growth they do not like. |
| Observing<br>Inferring | 5. Have students bring in photographs or pictures of living things which show some growth over a period of time. Have them make a series of drawings or a collection of pictures illustrating this growth according to increase in age. |
| Measuring<br>Data-collecting | 6. Is growth always visible? Have each child keep a record of his growth patterns. Make weekly measurements of their mass and heights. |
| Observing<br>Communication | 7. Have students plant some seeds so that they may critically observe the growth of another living organism. Devise a way of making measurements of growth that can be illustrated graphically. |
| Inferring | 8. Have students start a crystal garden. Is this kind of growth different from the growth of a plant or animal? What other examples of growth of non-living things can you identify? Use safety precautions in handling chemicals. |

B. *Question*

What contributes to and limits growth?

| *Processes* | *Suggested Procedure* |
|---|---|
| Experimenting<br>Data-collecting<br>Hypothesizing | 1. Either in groups or individually, give the children some seeds, soil, and a tray. Ask them to plant these seeds (peas, beans, or corn are best) and place this tray anywhere in the room. Then compare the growth results. Record data on time of germination, percentage of germination and rate of growth. Have the child devise ways of illustrating the data. Make comparisons between plants in different locations and try to determine why some plants grow larger and/or faster. |
| Experimenting | 2. Plant some seeds outside in a variety of environments. Again compare the results and ask the children to identify possible controlling factors. |
| Hypothesizing<br>Experimenting | 3. Have the children list the factors that they believe control the growth of their plants. How can they test their hypotheses? Assist them in developing means for testing these hypotheses. |

| | |
|---|---|
| Inferring | 4. Try to find the same species of plant in different environments around the school. (Note. Trees or ornamental plants are good.) How do the children explain the difference in growth? |
| Hypothesizing<br>Data-collecting<br>Valuing | 5. Is your school undergoing growth? How can you determine this? If so, what factors in your community account for this growth? Do you want more or fewer children in your school? If the population of your school is increasing, what changes may occur (i.e. more teachers, buses, cars, longer lunch lines, less instructional material for each child, a new school will have to be built)? Why are more people moving into your school community? If the school population is decreasing, what factors might account for this? |
| Hypothesizing<br>Data-collecting<br>Communication<br>Decision-making | 6. Is your community undergoing growth? If so, why? If not, why? Do you have some special resources that will support growth in your community? What happens if these resources are depleted? As more people move into your community what problems arise? Are there groups of people concerned with these problems? Can you help them to collect data and find solutions to these problems? |
| Inferring<br>Decision | 7. Are there economic factors present in your community that support or detract from its growth? Can you or members of your community influence these economic factors? |
| Hypothesizing<br>Data-collecting | 8. Is the continued growth of your community good? How do people in your community feel about growth? What ways could you get information about people's attitudes toward growth? What can you do with this information once you have it? |

C. *Question*

What are some consequences of unrestricted growth?

| *Processes* | *Suggested Procedure* |
|---|---|
| Data-collecting<br>Observing<br>Measuring<br>Inferring<br>Hypothesizing | 1. In a small plant flat or box, distribute a high concentration of seeds (radish, peas, or beans) and in a second container plant identical seeds but reduce the amount of seeds. Have students observe the growth patterns in each container for several weeks. Plot this data (height/time and germination rate). Students should record observations indicative of the general health of plants involved. What conclusions about growth can be reached? Do your data support these conclusions? What variations can you try on this experiment? |
| Data-collecting<br>Inferring | 2. If available, have students visit a local tree farm and record their observations about the spacing of seedlings. Why are there large unplanted areas between trees? Would you not have more trees if they were planted closer, yielding a higher economic return per acre? Are the concepts of growth and economics related? |
| Data-collecting<br>Communicating<br>Hypothesizing<br>Decision-making<br>Inferring<br>Valuing | 3. Can you identify some indicators of growth within your community (i.e. population, water usage and tax rate)? Find ways of illustrating these growth patterns visibly. If one of these growth factors is increasing, will it have an effect on other indicators of growth? Does there seem to be one central indicator of community growth? What can you as an individual do to influence this growth pattern? If the people of your community are encouraging specific patterns of growth, are they supporting certain values? What are these values and does everyone agree on them? How can you find out? Do you agree with them? |

| | |
|---|---|
| Data-collecting<br>Hypothesizing<br>Communicating | 4. Are the preceding growth indicators having any effect on your community's environment? What evidences of these can you identify? How can you make people aware of these effects? Are some effects short term and others long range? Do these growth indicators suggest any future changes in the environment of your school or classroom? |

## INVESTIGATION FIVE: ME IN MY ENVIRONMENT

### Goals and Objectives

The goals of this investigation are to help the student to better understand his environment, the way energy and materials in his environment influence him and are influenced by him, and the role of human ideas and values in the relationship between an individual and his environment. During the investigation, the student will:

1. Identify a large number of components which comprise his environment.
2. Distinguish among environmental components on the basis of living vs. nonliving and natural vs. man-made.
3. Identify those aspects of the environment which are subject to human influence.
4. Distinguish among environmental components in terms of those which are directly observable phenomena and those which exist as ideas or attitudes in a person's mind.
5. Produce an environmental interaction network reflecting the relationships among a number of environmental components, particularly as they directly or indirectly affect or are affected by people.
6. Consider reasons why people fail to consider many of the consequences of their interactions with the environment.
7. Determine ways in which students may influence better environmental decision-making.
8. Determine ways in which energy, materials, and ideas related to their environments influence them.
9. Distinguish between those environmental components which are essential for survival and those which contribute toward the quality of their lives.
10. Consider the difficulties encountered in attempting to change one's life style.
11. Examine those aspects of their environment which have emotional effects on them and the difficulty in changing these aspects of the environment.

### Questions:

A. What is the nature of my environment?
B. How do I affect my environment?
C. How does my environment affect me?

### Conducting the Investigation

A. *Question*

What is the nature of my environment?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing<br>Data-collecting | 1. Starting with the generalization that a person's environment is "everything that surrounds him", have the students devote a day to identifying as many dif- |

ferent examples of the components of their environments as they can. Prepare a list which includes all of the students' observations. For example:

| | | |
|---|---|---|
| a. air | h. heat | o. clouds |
| b. food | i. highway | p. rain |
| c. people | j. mountains | q. sounds |
| d. buildings | k. lakes | r. smells |
| e. plants | l. telephone poles | s. beauty |
| f. animals | m. laws | |
| g. automobiles | n. airplanes | |

Classifying
2. Distinguish which items in the list are living or non-living.

Classifying
3. Distinguish which items in the list are natural or man-made.

Classifying
4. Distinguish which items in the list can or cannot be influenced by the actions of people.

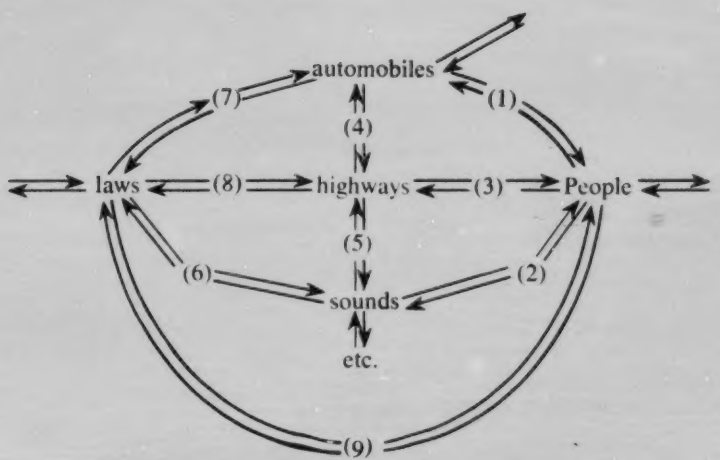
Classifying
5. Distinguish which items in the list are directly observable with the senses, exist for the individual because they trigger internal feelings (e.g., beauty), or represent human ideas which influence the environment (e.g., laws, architecture).

Valuing
6. Discuss the question: "Do two people standing side-by-side exist in the same environment?" Use the answers to develop the idea that human experiences and values play an important role in determining the ways in which they perceive their environment.

Inferring
7. Select any single item from the list in step 1 of this investigation. Examine it in terms of the ways in which it influences other items in the list and is influenced by other items in the list. For example, if the word "automobiles" is chosen as a starting point:

Observing
Inferring
Data-collecting
a. Place the word "automobiles" in the middle of the chalkboard or on a piece of paper. Then place nearby the name of another item from your list which either influences or is influenced by automobiles. Draw arrows between the two words which suggest the manner in which they influence each other. Continue to add words, each time checking for relationships between the added word and all others, in order to develop an environmental interaction network.

For example:



(1) Automobiles influence people: as a budgetable expense, in terms of mobility
People influence automobiles: in regulating the speed at which they move, in determining the number and kinds which are on the highways

(2) People influence sounds: by using automobile horns, by screeching tires in tight turns
Sounds influence people: by producing responses to automobile horns, warning them of danger (e.g., the sound of screeching brakes)

(3) People influence highways: by determining where they will be built, by putting limits on them
Highways influence people: by influencing where they can live and still commute to work, by occupying land that might be used for other purposes

(4) Automobiles influence highways: by use rates determining when highways should be widened or new highways built, by causing the need for repairs
Highways influence automobiles: by determining maximum safe speeds automobiles may travel, by determining routes automobiles must take between two points

(5) Highways influence sounds: in the way the road surface affects tire sounds, in determining the rate at which automobiles may travel and thus wind sounds accompanying rapidly moving automobiles
Sounds influence highways: by determining where highways are built (e.g., away from residential areas, hospitals)

(6) Sounds influence laws: as a stimulus for the enactment of sound abatement laws, as an influence on the development of zoning criteria
Laws influence sounds: by restricting sound-producing activities in the community, by regulating the construction of certain sound-producing devices (e.g., mufflers on automobiles)

(7) Automobiles influence laws: by producing a need for traffic regulations, rights of way
Laws influence automobiles: by regulating the dimensions, emission properties of exhaust gases, other characteristics

(8) Laws influence highways: by regulating where they may be built, construction characteristics
Highways influence laws: by providing a "history" on which highway regulations can be based

(9) Laws influence people: by regulating their use of automobiles, highways
People influence laws: in comprising the governmental bodies which make laws, making judgments as to the need for laws

Observing
Inferring
Data-collecting

b. Find instances in your interaction network where words in the network are not connected directly by arrows to the word "people." By examining the network, determine if these words connect indirectly with "people" by interacting with words which do connect with the word "people." Try to identify as many instances as possible where elements of a person's environment influence him, or are influenced by him, in this indirect manner.

Predicting

c. Examine the interaction network in terms of the events indicated below and predict the consequences of these events in terms of the network:

(1) completion of the Alaskan Oil pipeline
(2) political unrest in the oil-producing countries of the Middle East
(3) development of an economical electric automobile
(4) diversion of federal funds from highway construction to the development of nationwide mass transit systems

B. *Question*

How do I affect my environment?

| *Processes* | *Suggested Procedure* |
|---|---|
| Data-collecting | 1. Add to the list of indirect influences compiled in answer to Question A, part 7b, ways in which people directly influence their environments. For example:<br>a. purchasing food, clothing<br>b. using heating fuel, gasoline, electricity<br>c. using water<br>d. disposing of trash, garbage, and other wastes<br>e. burning papers, leaves |
| Inferring | 2. Examine the combined list of direct and indirect environmental influences and consider the following questions:<br>a. What accounts for the fact that people often fail to consider many of the consequences of their interactions with the environment? For example:<br>(1) They do not know about some of the consequences.<br>(2) They do not care about some of the consequences.<br>(3) Many of the consequences are felt at some distance from the individual observer and thus cannot be observed directly.<br>(4) Many of the consequences do not occur immediately and thus are remote in time.<br>(5) People establish value-based priorities which may not take into account the environmental impact of their actions. |
| Inferring<br>Hypothesizing | b. How can students influence better environmental decision-making? For example:<br>(1) by learning more about environmental interactions themselves<br>(2) by helping to inform their parents, other students, and members of the community<br>(3) by modifying their behavior in ways that lead to better "environmental management"<br>(4) by supporting, through their parents, leigslation designed to protect the environment |

C. *Question*

How does my environment affect me?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing<br>Classifying | 1. Survey your total environment and determine those things affecting you which might be classified as: |

a. materials—for example:
   (1) air
   (2) paper
   (3) metal
   (4) plastic
   (5) various liquids

b. energy (or energy sources)—for example:
   (1) heat
   (2) light
   (3) electricity
   (4) gasoline
   (5) heating fuel

c. ideas—for example:
   (1) beauty
   (2) ugliness
   (3) laws
   (4) conventions

Decision-making

2. Examine your lists of materials, energy sources, and ideas which comprise your environment and determine those which are essential for survival (i.e., your continued ability to remain alive). For example:

   a. heat
   b. food
   c. water
   d. clothing
   e. shelter

Observing
Valuing

3. a. If the above list identifies the necessities for survival, it might be said that other environmental factors influence the quality of one's life. Consider the following list of activities which are not essential to survival and decide why you choose to participate in them:

      (1) participation in interscholastic athletics
      (2) riding the school bus rather than walking to school
      (3) hiking, boating, riding and other forms of recreation
      (4) using an air conditioner in your home
      (5) using an automatic dishwasher in your home
      (6) flying to a distant community instead of driving an automobile

   b. How are your answers to the above related to your life style? Can you change your life style? Would you want to?

Data-collecting

4. a. Choose an activity which is a characteristic part of your life style, but which is not necessary to your survival, and try to omit it from your daily activities for a week. For example:

      (1) Walk to school instead of riding the bus.
      (2) Turn off the water heater in your home.
      (3) Use no throw-away articles.
      (4) Use no "labor-saving" devices (electric dishwasher, vacuum cleaner).

b. How did the omission of this activity affect you? Would it be easier to change your life style if everyone else did too?

Valuing

5. What aspects of your environment affect you emotionally (i.e., make you angry or sad, fill you with a sense of beauty)? Why might it be more difficult to change these aspects of your environment than to alter those involving materials or energy?

## INVESTIGATION SIX: SOUND

**Goals and Objectives**

The goals of this investigation are to have students examine the nature of sound, the diversity of sounds in their environment, the ways in which environmental sounds affect people, and the ways in which human behavior affects sound in the environment. During this investigation, students will:

1. Determine the nature of sound and its properties.
2. Determine the range of sounds in the classroom and the activities which produce them.
3. Identify the roles of various sounds in the classroom.
4. Determine the various roles of vocally-produced sounds in influencing human activity.
5. Survey the variety of sounds encountered in their homes, the events that produce them, and the effects they have on people.
6. Survey the variety of sounds encountered in the community, the events that produce them, and the effects they have on people.
7. Examine the means people employ in coping with the great variety of sounds they encounter in the environment.
8. Determine the health aspects of sound in the environment.
9. Reveal their knowledge and concerns about sound in the environment through written expression.
10. Examine the rules and conventions used to regulate sound-producing activities in the classroom.
11. Evaluate the means by which rules governing sound levels in the classroom are determined.
12. Determine the rules and conventions employed in regulating sound-producing activities in the homes.
13. Determine the laws and regulatory devices employed in governing sound-producing activities in the community.
14. Identify agencies in the community responsible for creating and enforcing sound abatement ordinances.
15. Determine recent changes in sound abatement ordinances in the community.
16. Determine the attitudes of people in the community regarding current sound abatement regulation and the need for new ordinances.
17. Evaluate alternatives in personal behavior relative to the reduction of sound levels in the community.

**Questions:**

A. What is sound and what are its properties?
B. How does sound in the environment affect people?
C. How do people affect sound in the environment?

**Conducting the Investigation**

A. *Question*

What is sound and what are its properties?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing | 1. Have the students produce as many different sounds as they can in the classroom. Provide as many different objects as possible made from wood, plastic, glass, etc. By means of touching, listening, and observing effects (e.g. touch a vibrating tuning fork to water) of sound-producing objects, develop the generalization that sound is produced by vibrations of objects. |
| Observing | 2. By examining the nature of different objects which produce sounds and the ways in which the sounds are produced, determine that the quality of sound varies in pitch, tone, and volume. |
| Data-collecting | 3. Give pairs of students two paper or plastic cups with small holes punched in the bottom. Have the students stand about 20 feet apart with one speaking into a cup and one listening with the other cup. Do this with:<br>a. no connection between the cups<br>b. a metal wire connecting the cups<br>c. a plastic line connecting the cups<br>d. a piece of string connecting the cups<br>Are there differences in the effectiveness of sound transmission in each case? What materials seem to conduct sound most effectively? Least effectively? |
| Data-collecting | 4. Place a small mechanical alarm clock in a cardboard box after first setting it to ring within a few minutes. Fill the box, successively, with various materials (e.g. "wadded" paper, paper strips, styrofoam pieces) and listen carefully when the alarm goes off to determine differences in the loudness of the alarm bell. Have the students try different materials and ways to make the sound of the alarm quieter. Develop the concept of sound insulation and the recognition that different materials have different insulating effects. |

B. *Question*

How does sound in the environment affect people?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing | 1. a. Identify as many sounds as possible which occur in the classroom. For example:<br>(1) teacher talking<br>(2) students talking<br>(3) people walking<br>(4) chairs and desks scraping the floor<br>(5) books dropped on desks<br>(6) sounds of heater and/or air conditioner<br>(7) clock ticking<br>(8) bells ringing |

Classifying

b. Examine the list of sounds and determine which ones are:

Valuing

(1) necessary
(2) helpful
(3) annoying
(4) pleasant

2. a. Choose a simple game, such as dodge ball, for the class to play. Have them play silently (i.e., with students making no verbal sounds). After the game is over, discuss the effects of playing the game silently. Student reactions might include:

Valuing

(1) "It wasn't fun because we couldn't laugh or shout."

(2) "We couldn't warn other kids that they were going to get hit with the ball."

(3) "It was 'unnatural'—kids need to make sounds."

(4) "I felt frustrated because I couldn't make any sound."

b. After examining the student reactions to the silent game, determine the functions that sound normally has in the game. For example:

Classifying

(1) emotional expression
(2) release of tension
(3) clarification of rules
(4) friendly communication

Observing
Classifying

3. Conduct a survey and analysis of sounds heard around the home. (Students may want to use a tape recorder to "collect" a complete set of sounds from their home environment.)

Observing
Classifying

4. Similarly, survey and analyze the range of sounds one hears around the community. For example:

a. automobiles, mortocycles, busses, and trucks
b. honking horns of various vehicles
c. factory whistles and factory operating sounds
d. street repair equipment
e. airplanes
f. background music in banks, department stores
g. the wind
h. the jingling bell on an ice cream truck
i. birds singing
j. farm animals
k. farm equipment
l. fire, police and ambulance sirens

5. With so many different sounds in the environment, how do people cope with all the sound information available? For example:

Observing

a. by "tuning out" all but the sounds which are of particular interest (e.g., ignoring classmates whispering in order to listen to the teacher, excluding other household sounds in order to listen to the radio)

b. by assigning different importance to sounds (e.g. "important" sounds requiring high priority reactions might include a baby crying, sirens of emergency vehicles, fire alarm bell, angry or threatening tones in people's voices)

c. by establishing laws, rules, and conventions which minimize or exclude sounds under various circumstances (e.g. "no talking rule" during tests, silence rules in the school library, "quiet zones" around hospitals, laws requiring mufflers for automobile exhaust systems, "truck routes" in communities)

d. by using devices to limit sounds (e.g. insulated ear protectors for airplane services personnel, a headset for listening to the "Hi-Fi", sound-proof rooms for recording studios, mufflers for internal combustion engines)

Data-collecting

6. Interview a doctor who specializes in hearing disorders. Determine:
   a. the volume at which sounds have destructive effects on ear functions and the kinds of sounds which are most dangerous to human hearing
   b. if there has been any increase in the frequence of hearing disorders treated by the doctor over a period of ten years
   c. the difference between temporary and permanent hearing loss and the causes of each
   d. how effective hearing aids are in helping people cope with hearing losses
   e. precautions the doctor recommends to minimize the danger of hearing loss

Inferring
Valu[illegible]

7. Have the students write a story about one of the following:
   a. a person who has hearing that is ten times as sensitive as that of a normal person
   b. a person who can hear all sounds except those made by other people
   c. a person who lives on a planet identical to Earth except that the atmosphere does not transmit sounds

### C. *Question*

How do people affect sound in the environment?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing | 1. Identify as many rules and conventions as you can that influence the production of sound in your classroom. For example:<br>a. minimizing the loudness of sounds (e.g., whispering, placing books gently on desks, walking rather than running, moving closer to speak to someone rather than speaking from a distance)<br>b. speaking individually rather than all at once<br>c. regulating activities so that those which produce high sound levels do not occur at the same time as those which require a quieter environment<br>d. arranging for activities with high sound levels (e.g., physical education, recess, lunch periods) to occur outside the classroom |
| Observing<br>Inferring | 2. For one hour, waive all rules and conventions relating to the production of sound in the classroom. What are the results? |

Observing
Communicating
Valuing

3. Re-examine the rules and conventions which were waived in step 2. Can you see advantages to adding or deleting any of these procedures? Have the class discuss sound regulation and produce the minimum set of rules which most of the students agree are necessary.

Observing
Inferring
Decision-making

4. Are there sounds which occur outside the classroom but influence the classroom environment? What effect does the establishment of rules for the classroom use of sound have on these external sounds? How can students and teachers influence sounds outside the classroom?

Observing
Inferring

5. Examine the variety of sounds which influence you in your home and identify rules and conventions which regulate sound production in that environment. For example:

   a. not using the power mower early in the morning when members of the family and neighbors may be sleeping
   b. turning on the automatic dishwasher at times when it doesn't interfere with conversation, radio-listening, or watching television
   c. minimizing all sounds late at night when people are sleeping in your home
   d. members of the family taking turns speaking to each other at the dinner table
   e. being especially quiet when a member of the family is ill
   f. locating a home workshop in the cellar or garage to minimize sound levels of workshop activities elsewhere in the home

Observing
Inferring

6. Examine the various types of sounds produced in the community and determine the laws and regulatory devices used to influence them. For example:

   a. quiet zones around hospitals and nursing homes
   b. restrictions on traffic in residential areas
   c. regulations governing mufflers on vehicles with internal combustion engines
   d. location of airports some distance away from communities
   e. regulation of flight paths to minimize flights of aircraft over communities

Data-collecting

7. In regard to sound-level regulations in the community, determine:

   a. what agencies make the regulations
   b. how residents in the community may influence anti-noise regulations
   c. what developments in the community in the past ten years influenced the creation of anti-noise regulations
   d. what regulations are currently being considered for adoption
   e. what sound-level regulations, if any, people in the community would like to see adopted but which are not under consideration by regulatory agencies

D. *Value Questions*

Valuing

1. Would you be willing to spend fifty dollars extra for a motorcycle with an exceptionally effective sound muffling system?

Valuing

2. If the motorcycle described above produced dramatic reductions in sound levels but reduced your mileage by 50%, would you buy it?

Valuing

3. When people's sound-producing activities disturb you, do you believe it is because (a) they don't realize they are disturbing you, or (b) they don't care if they disturb you?

Valuing

4. If a particularly noisy manufacturing plant is located in your community:
   a. Does the plant management have the right to produce any sound levels they wish because it is their property on which the plant is located?
   b. Do community agencies have the right to impose anti-noise regulations on the plant because it is part of the community and subject to community ordinances?
   c. Do you have the right to complain to the plant management because they are contributing to your environment in a way which disturbs you?

## INVESTIGATION SEVEN: DRINKING WATER

**Goals and Objectives**

The goals of this investigation are to help students better understand the roles of drinking water in their lives, the means by which it is made safe for consumption, and how the purification and distribution of drinking water influences, and is influenced by, other aspects of the environment. During this investigation, students will:

1. Determine the means by which drinking water is distributed in their homes.
2. Identify a variety of uses for drinking water in their homes.
3. Determine the nature and extent of the community drinking water distribution system.
4. Trace the origins of drinking water prior to processing in a purification plant.
5. Determine uses of drinking water which do not require that it be purified.
6. Determine the standards employed in describing water which is safe to drink.
7. Determine the methods employed in water purification plants.
8. Determine the factors which influence demand on the purification capacity of a water purification plant.
9. Determine the cost of water purification to the community.
10. Identify human activities which affect water in such a way that it must be purified for drinking purposes.
11. Relate purification plant capacity to demand patterns in the community over a period of years.
12. Determine the various individuals and agencies in the community which draw upon the drinking water supply and the relative amounts required by each.
13. Make judgments as to the "necessity" of a variety of uses for purified water in their homes and in the community.
14. Consider the choices available to them in making wiser use of drinking water.

Note: The procedures suggested in the investigations which follow might be easily adapted to a study of food in the environment (e.g., food-use practices, procedures for diminishing food wastage, community agencies responsible for regulating food processing, distribution and storage)

**Questions:**

A. What is the origin of the drinking water which comes from a tap?
B. What steps are taken to insure that water is safe to drink?
C. Are there limits to the supply of drinking water?

**Conducting the Investigation**

A. *Question*

What is the origin of the drinking water which comes from a tap?

| *Processes* | *Suggested Procedure* |
|---|---|
| | 1. Have the students investigate the network of pipes which makes up the water distribution system in their homes to determine what uses, other than for drinking, water has in their homes. For example: |
| Observing | a. in toilets<br>b. in showers and sinks<br>c. in washing machines<br>d. in refrigerators with automatic ice-makers<br>e. in heating systems with humidifiers<br>f. in automatic dishwashers<br>g. for disposal units in sinks<br>h. for lawn sprinkling and other outdoor uses |
| | 2. Compose a letter to an official of the community water department inviting him to visit the class and/or to answer questions concerning the origins of water entering their homes from the community water distribution system. Among the questions which might be raised are the following: |
| Data-collecting | a. What is the nature and extent of the community water distribution system? (A map of the community showing the water distribution system is probably available for this purpose.)<br>b. What is the origin of water entering the community distribution system?<br>c. What is the origin of water entering the community's purification plant(s)?<br>d. Where does water which falls in the form of rain or snow originate? |
| | 3. What tentative conclusions may be drawn from the information gathered in the previous investigations concerning: |
| Inferring | a. the need for purified water for various household uses<br>b. the relationship among various bodies of water and the water we drink |

B. *Question*

What steps are taken to insure that drinking water is safe to drink?

| *Processes* | *Suggested Procedure* |
|---|---|
| Data-collecting | 1. Contact the community health department to determine the standards employed in describing water that is safe to drink. Determine:<br>a. acceptable levels of suspended particles<br>b. acceptable levels and kinds of microorganisms<br>c. what toxic substances must be removed<br>d. requirements related to unpleasant odors |
| | 2. Arrange a visit to the local water purification plant to determine: |

Data-collecting

a. the various methods used to purify water (e.g., filtration, aeration, chemical treatment)
b. the rate at which purified water can be produced for community consumption
c. seasonal variation in water treatment practices
d. daily and seasonal variation in water demand by the community
e. human activities which affect water in such a way that it requires purification
f. the cost to the community of maintaining the water purification plant and the way in which these costs are met.

3. What tentative conclusions may be drawn from the information gathered in the previous investigations concerning:

Inferring

a. the role of community agencies in safeguarding the health of the resident?
b. the factors which affect water in such a way that it must be purified before being consumed by humans?
c. the cost to the community for supplying water which is safe to drink?
d. the factors which tend to increase the costs of water purification over the years?

C. *Question*

Are there limits to the supply of drinking water?

*Processes* — *Suggested Procedure*

1. From officials at the local water purification plant (See Question B, step 2), solicit information to help determine:

a. the relationship between the purification plant capacity and community demand over the past ten years.

Data-collecting

b. the percentage of purified water in the community used by:

(1) various industries
(2) various commercial establishments (e.g., car washes, laundries)
(3) institutions (e.g., schools, hospitals)
(4) private homes
(5) hotels and motels

Data-collection

c. the relationship between water purification costs and the quality of water entering the purification plant during a ten year period

Data-collecting

d. the cost of labor and maintenance for operating the purification plant during the same ten year period

Data-collecting

e. the relationship between the intake volume for the water purification plant and the volume in the community water supply during the same ten year period.

2. Have the students survey their homes and the community to determine:

Valuing

a. if water-use practices they observe are "necessary"

Data-collecting

b. if the volume of water used exceeds the minimum requirements for that function—for example:

(1) too-frequent use of automatic dishwashers
(2) excessive volumes of water for flushing toilets
(3) leaking water fixtures
(4) lawn-watering during the hottest hours of the day when evaporation rates are highest

Inferring — 3. Compare the findings in 2a and 2b(3). Are there any relationships between water-use practices and the long-term changes in demand on water purification capability in the community?

Valuing — 4. If taking a bath uses less water than taking a shower, yet you prefer showers, are you willing to change your bathing habits to reduce the demand on purified water?

Valuing — 5. If the supply of drinking water in your community should become limited, which of the following groups should get preference in the use of available water: private homes, institutions or industries?

## INVESTIGATION EIGHT: WASTE WATER

### Goals and Objectives

The goals of this investigation are to help students better understand the concept of waste water, how waste water production relates to human activity, and the environmental impact of production and removal of waste water. During the investigation, students will:

1. Identify practices in their homes which produce waste water.
2. Determine activities in the community which produce waste water.
3. Develop a comprehensive definition of waste water.
4. Observe the system for waste water removal in their homes.
5. Determine the destiny of waste water produced in the community.
6. Identify the community storm and sanitary sewer system and their functions.
7. Determine the cost to the community of building and maintaining storm and sanitary sewer systems.
8. Observe a sewage treatment plant and determine its function and its cost to the community.
9. Assess the possibilities for developing water recycling capabilities in the community.
10. Determine the relationship between the practice of paving over exposed soil and its effect on water run-off in the community.
11. Examine the need for using purified drinking water as a vehicle for carrying away home and industrial wastes.
12. Examine practices which would diminish the rate at which waste water is produced in the home and in the community.
13. Consider value-based questions relating to their activities and the production of waste water.

### Questions:

A. What is waste water?
B. Where does it go?
C. How does waste water affect people?

### Conducting the Investigation

A. *Question*

What is waste water?

*Processes* — *Suggested Procedure*

Observing — 1. Have the students survey water-use practices in their homes. For example:

a. when water is "run" to allow it to get cold or hot
b. when, after washing clothes and dishes, water is allowed to drain away
c. when water is used to flush a toilet
d. when excess water from car-washing runs down to the curb
e. when water used in the operation of a sink waste disposal unit runs down the drain

Observing

2. Survey the community to determine situations which required the disposal of excesses of water. For example:

a. rain and melting snow which run into the streets
b. water used in fire-fighting
c. industrial processes which employ large amounts of water
d. street cleaning activities

3. Discuss the preceding findings and develop the concept of waste water as a generalization which includes the examples listed.

B. *Question*

Where does waste water go?

| *Processes* | *Suggested Procedure* |
|---|---|
| Observing | 1. Have the students examine the system of pipes in their homes which lead from various drains and toilets to the point where a large pipe carries waste water into the community sanitary sewer system or septic tank and drainage field. |
| Observing | 2. In relation to the other examples of waste water identified in answer to question A trace the destiny of the water. For example:<br>a. it is absorbed by soil<br>b. it runs into a storm sewer system<br>c. it runs into a body of running or standing water |
| Data-collecting | 3. Compose a letter to an official of the community sewer department inviting him to meet with the group. Raise questions such as the following:<br>a. What is the nature and extent of the community's storm and sanitary sewer system? (A map of the community showing the storm and sanitary sewer network is probably available for this purpose.)<br>b. What is the destiny of water discharged from the storm sewer system?<br>c. What is the quality of the water discharged from the storm sewer system?<br>d. Does water discharged from the storm sewer system affect other communities?<br>e. What is the destiny of water discharged from the sanitary sewer system (e.g., sewage treatment plant)?<br>f. What does it cost the community to maintain the system of storm and sanitary sewers?<br>g. What has been the growth rate of storm and sanitary sewer systems over the years? |
| Data-collecting | 4. Have the students visit a local sewage treatment plant to determine:<br>a. the procedure used in treating sewage<br>b. the nature and destiny of the solid product (sludge) of the treatment process<br>c. the quality and destiny of the water treated by the plant |

d. the capacity of the sewage treatment plant
e. the volume of untreated sewage generated daily by the community
f. the relationship between the volume of daily untreated sewage and the plant's treatment capacity over ten years

Inferring

5. What tentative conclusions may be drawn from the information gathered in this investigation concerning:

a. the relationship between the generation of waste water and your community's capacity for dealing with it
b. the influence of waste water on bodies of standing and running water in the community
c. the usefulness of sludge produced by sewage treatment plants
d. the possibilities for recycling water in the community

C. *Question*

How does waste water affect people?

*Processes* *Suggested Procedure*

1. On the basis of your findings (collect additional data where necessary), discuss the following questions:

a. Since rain and snow falling on a community are a potential source of fresh water:

Inferring (1) What is the effect of carrying off excess surface water by means of a storm sewer system?

Inferring (2) What is the effect of paving over exposed soil for parking lots, roads and homesites?

Data-collecting (3) Are there any provisions for the collection and storage of this water?

b. Since much water in homes, institutions and industries is used as a vehicle for carrying away wastes from their point of origin:

Inferring (1) Is it necessary for water to have been purified for drinking purposes in order to serve this function?

Inferring (2) Is it feasible to have separate drinking and waste water systems in homes and industries?

Data-collecting (3) What does the practice of using purified water for the transport of wastes cost the community?

c. In situations where large volumes of waste water are generated (car washes, industrial processes):

Data-collecting (1) Is it feasible to recycle water for use in these situations?

Observing (2) Are there water recycling procedures being used? (interview officials of commercial car washes, industries)

Data-collecting

2. How does the use of street-cleaning machinery affect the costs of waste water removal in your community?

3. What practices might reduce the rate of waste water production in your community? For example:

a. dry toilets, where wastes are treated chemically to deodorize them and wastes are periodically disposed of using no water at all
b. water recycled in the home. For example:

(1) rinse water from automatic washing machines used for cleaning cars and other washing purposes
(2) rinse water from automatic dishwashers used for a variety of heavy duty washing purposes

c. using automatic dishwashers and clothes washers when loaded to maximum reduces the number of loads that produce waste water

Valuing

4. Would you use a dry toilet rather than a flush toilet in order to reduce the use of drinking water and the production of waste water?

Valuing

5. Would your parents be willing to pay for the installation of a separate water system for unpurified water to be used for non-drinking uses if it were to become available?

# A. Administering the Environmental Education Program (Grades 8-12)

Comprehensive environmental education programs are recent arrivals on the curricular scene. They have no long-standing tradition upon which local school programs might be based. An environmental education program is not a course to be taken at a particular grade level. Rather, it possesses a special kind of emphasis which should exist at all grade levels and transcend conventional subject-matter courses. It should deal with phenomena of many different types. It should deal with beliefs, attitudes, and values. Effective learning experiences may be developed around an almost endless number of environmental settings. How, then, is a local program to be developed?

Teachers and administrators should examine the activities which are provided in this guide as models of potentially valuable experiences for students. Investigations Nine through Seventeen are designed primarily for secondary students. For additional assistance in developing a local environmental education program, the following suggestions may be helpful:

1. Programs must be developed cooperatively with teachers at all grade levels and from every relevant subject area. Faculty meetings or special planning sessions should be called for cooperative planning.
2. Special support for equipment and materials may be needed for the satisfactory implementation of the program.
3. If they do not already exist, consideration should be given to establishing policies which would permit students to leave the school grounds for supervised environmental studies *during school hours.*
4. Guidance for students in the selection and implementation of environmental investigations may be provided by a team of teachers representing different subject areas, or by individual teachers with specialized training in environmental education.
5. The daily schedule of the school may have to be modified to provide a time when student environmental investigation teams can meet with groups of teachers or other teams of students.
6. Decisions to determine what environmental investigations to pursue should be made by the students with the guidance of teachers. After several investigations of the type suggested in this guide, students should be encouraged to design other useful investigations.
7. The environmental education program should not become an enrichment program for superior students but a program for all students.
8. One very important function of the teachers who participate in student investigations is to monitor the activities of all student teams to avoid the possibility of students from different classes making demands on the same citizens and local governmental agencies at the same time.

# B. Exemplary Investigations (8-12)

## INVESTIGATION NINE: AESTHETIC EXPERIENCES IN THE ENVIRONMENT

### Goals and Objectives

The goals of this investigation are to help the student examine more closely aesthetic aspects of his environment and the ways in which aesthetic aspects of his environment influence him and are influenced by him. During the investigation, the student will:

1. Identify aspects of the environment which produce both pleasant and offensive reactions.
2. Examine aesthetic values among people in relation to age, experiences, and associations with particular aspects of the environment.
3. Consider aesthetic experiences in people's lives.
4. Examine aesthetic considerations in planning changes in the community.
5. Examine the role aesthetic considerations play in purchasing habits of people as they relate to other criteria employed in deciding on purchases.
6. Examine aesthetic considerations in determining where people choose to live in a community.
7. Consider the ways people emphasize pleasant aesthetic experiences and minimize offensive ones.
8. Determine the ways people make their homes and property more aesthetically pleasing.
9. Identify some non-aesthetic considerations of placing utility poles in the community.
10. Examine community agencies' regulation of aesthetic concerns in environmental decision-making.
11. Determine the relationship between aesthetic considerations and other factors influencing architectural planning.

**Questions:**

A. What are aesthetic experiences?
B. In what ways does the environment affect people aesthetically?
C. In what ways do aesthetically-motivated decisions influence the environment?

**Conducting the Investigation**

A. *Question*

What are aesthetic experiences?

*Suggested Procedure*

1. Using the generalization that aesthetic experiences are "those experiences which trigger a sense of beauty in the beholder," have the students prepare a list of subjects which produce aesthetic experiences for them. For example:

   a. a musical selection
   b. a person
   c. a fragrance
   d. a photograph
   e. a painting
   f. a ceramic object
   g. a building
   h. ocean waves
   i. a field of grain
   j. a mountain brook
   k. a city skyline
   l. an airplane in flight
   m. an erupting volcano
   n. smoke billowing from a smokestack
   o. a pond covered with algae

2. Using photographs, paintings, prints, recordings or the objects themselves identified in A1, have all the members of the class react to the items contributed by individual students. Try to determine the nature of an aesthetic experience by having the students react to the following:

   a. Do most, or all, of the class members agree on the aesthetic impact of these various subjects?
   b. If there is disagreement among class members regarding the aesthetic appeal of these subjects, have the class discuss the basis for their reactions and attempt to explain why there are differences. For example:

      (1) Do people who have lived at the seashore react the same way to the sound and sight of breaking waves as people who only occasionally visit the shore?

(2) Do people who have not listened to much classical music react the same way to it as people who have listened to it a great deal?
(3) Does a person's aesthetic sense vary with age? (Students may wish to collect data on the reaction of older and younger students, teachers, parents and compare to the class reactions to the same items.

c. Examine the various subjects identified above as sources of aesthetic pleasure and try to identify the basic characteristics of each that combine to produce aesthetic responses. For example:

(1) color
(2) texture
(3) shape
(4) fragrance
(5) sound

3. Have students repeat the procedures in step 2, this time collecting examples of subjects which are known to be aesthetically offensive to some. Again solicit class responses to each subject, and examine the basic cleanup components of these subjects. Have students try to form generalizations concerning:

a. beautiful vs. offensive colors
b. beautiful vs. offensive textures
c. beautiful vs. offensive shapes
d. beautiful vs. offensive smells
e. beautiful vs. offensive sounds

4. Have students discuss the effects of both pleasant and offensive aesthetic experiences on people. How desirable or necessary is it to provide pleasant and avoid offensive aesthetic experiences in one's life? To what extent can an individual control the aesthetic aspects of his environment? Should aesthetic environmental aspects be controlled? Who should make the decision on what aesthetic environmental aspects are to be controlled?

B. *Question*

In what ways may the environment affect people aesthetically?

*Suggested Procedure*

1. Have the students identify some experiences from their daily lives which they consider aesthetically satisfying to them. For example:

a. lying on a lawn on a sunny day
b. listening to a particular musical composition
c. attending an art show
d. creating artistic or musical expressions of one's feelings
e. listening to the early morning sounds of birds singing
f. sitting by a glowing fire reading a book
g. watching the launching of a rocket
h. musical sounds of the wind playing through the electric wires and light poles

2. Have the students identify some experiences from their daily lives which they consider aesthetically offensive to them. For example:

a. loud noises of traffic or road repairs
b. new buildings which block a former view of the countryside
c. clothing with clashing colors and patterns
d. penetrating ring of the bell signalling the end of a class
e. clatter of a typewriter
f. destruction of trees on a wooded lot to construct new homes
g. automobiles with unattractive colors and styling
h. billboards
i. modern art

3. Have students interview some residents of the community to determine those sights, sounds and smells which they consider to be either aesthetically pleasing or offensive and draw conclusions based on their findings.

   a. Do people living near the center of a community seem to have the same aesthetic values as those living on the outskirts of a community?
   b. Is there a relationship between a person's environmental exposure and his aesthetic response to it? For example:

      (1) Is a factory worker as disturbed by the sight of heavy, dark-colored smoke billowing from the factory where he works as a non-factory worker?
      (2) Is a department of sanitation worker as offended by the sight and smell of garbage as other members of the community might be?
      (3) Is a real estate developer as disturbed at the prospect of cutting down a wooded area to build homes as people in the surrounding neighborhood?
      (4) Is the head of a construction company as disturbed as other members of the community at the prospect of demolishing a historical landmark to make way for new construction?
      (5) Is a rural family deprived of electricity for many years concerned about the location of wires and poles?

4. Using some of the recent changes in your community (e.g., a new building, highway, or parking lot) involve students in the following activities:

   a. How do you react to this change in aesthetic terms?
   b. Interview residents of the area in which the change occurred to determine:

      (1) their aesthetic response to the change
      (2) other values they hold which may have overridden their aesthetic response to the change

   c. Interview the owner of the property, the architect, the builder, and representatives of involved community agencies to determine the extent aesthetic factors were taken into consideration.

5. Have student:

   a. consider items he has purchased in the past to establish a relationship between aesthetic characteristics, cost, convenience, and availability in the decision of his purchases
   b. determine to what extent this aspect of his environment is controlled by manufacturers to influence his buying patterns

c. interview a representative of a manufacturing plant's marketing division to determine the extent to which customers' aesthetic preferences are considered in marketing the product

6. Have students:

   a. examine the role aesthetic considerations play in influencing decisions about where people choose to live in a community
   b. identify pleasing characteristics of his neighborhood and survey the community to determine if there is any relationship between the socio-economic status of people and the aesthetic qualities of the homes and neighborhoods
   c. discuss the differences in their findings
   d. determine if there is a right answer for all

C. *Question*

In what ways may aesthetically-motivated decisions influence the environment?

*Suggested Procedure*

1. Referring to the findings of Question B, parts 1 and 2, have the student indicate ways to aesthetically control their environments. For example:

   a. including aesthetically satisfying experiences in their daily activities (e.g., walking home from school on a beautiful spring day or planning a special time for listening to records)
   b. avoiding people, places and things which are aesthetically offensive
   c. ignoring those aesthetically offensive experiences which cannot be avoided
   d. making changes in his environment in order to make it more aesthetically satisfying (e.g., decorating one's bedroom, mowing the lawn, or washing the car)

2. Have students survey homes in the neighborhood to determine ways people select their property or make it more aesthetically pleasing. For example:

   a. choosing attractive architectural designs for homes
   b. planting trees, shrubs, and flower borders on their property
   c. painting buildings and keeping them in repair
   d. mowing lawns and trimming hedges
   e. raking lawns and removing debris from their property
   f. choosing neighborhoods in which there are a variety of home designs rather than a single, repeated design

3. Have students compare their findings in the previous activity and determine the extent they agree on the best means for making personal property more aesthetically pleasing.
4. Many people believe that utility poles detract aesthetically from the appearance of a neighborhood. Have students interview officials of local utility companies (i.e., those providing electrical and telephone service) to determine:

   a. why utility poles are placed alongside thoroughfares
   b. alternatives to the conventional location of utility poles
   c. reasons why alternative locations are not used frequently (e.g., cost, accessibility, technological restraints)

5. Have students determine if the energy involved and the materials required to move utility cables underground is justifiable in view of the fuel shortage and identify the changes that might occur to the environment if utility cables were placed underground.
6. Have students interview officials of community agencies involved in the enactment and/or enforcement of laws which determine the concern of these agencies. For example, laws regulating:

   a. building characteristics and locations
   b. noise levels of highways
   c. location of highways
   d. condition of water in streams and rivers
   e. characteristics and location of sanitary landfills
   f. automobile exhaust emissions
   g. emissions from industrial smokestacks

7. Have students interview local architects, builders, or developers. Have them:

a. determine how aesthetic considerations enter the planning and design of buildings and the "trade off" which occurs among aesthetics, costs, availability of construction materials, and building codes in the design of a building
b. determine the extent people in the community influence the design decisions made by the architect
c. discuss their findings and come to some conclusions in terms of any recommendations that might be made to a planning commission

## INVESTIGATION TEN: ENERGY IN THE ENVIRONMENT

**Goals and Objectives**

The goals of this investigation are to help students examine more critically the nature and role of energy in their environment, how energy affects them, and how their activities affect energy. During this investigation, the student will:

1. Develop a concept of energy as a necessary environmental phenomenon.
2. Consider the principal energy sources in the environment.
3. Compare the impact of energy sources on the environment and on people.
4. Review student activities which require energy.
5. Compare current energy-use patterns in their community with those used there in the past.
6. Determine the way energy-related activities in the environment affect people aesthetically.
7. Determine the energy costs to their families during a year.
8. Correlate the results of various energy-related activities with environmental degradation.
9. Examine various transportation alternatives, energy consumption and atmospheric pollution.
10. Consider energy use patterns in the school and ways energy might be conserved.
11. Examine energy use practices in their homes and changes which would diminish energy requirements.
12. Consider laws which regulate energy-based activities in the community and the manner in which such laws are proposed and enacted.

**Questions:**

A. What is energy?
B. In what ways does energy in the environment affect people?
C. In what ways do people affect energy in the environment?

**Conducting the Investigation**

A. *Question*

What is energy?

*Suggested Procedure*

1. Energy is frequently described as the capacity to do work, and work is considered to have occurred when a force causes an object to move. In terms of human activity, have students determine:

   a. What kinds of work are done by the human body? For example:

      (1) beating of the heart
      (2) circulation of the blood
      (3) walking
      (4) running
      (5) lifting
      (6) breathing
      (7) typing

   b. Where humans get the energy used in maintaining their body functions (i.e., from food which they consume from their external environment).
   c. How materials in the previous activity acquire energy (i.e., plants directly from sunlight and animals from plants).

2. Have students determine other ways environmental energy influences the lives of people. For example:

   a. It is needed to operate kitchen ranges, blenders, electric can-openers, automatic dishwashers, automatic clotheswashers, automatic clothesdryers, steam irons, toasters and clocks.
   b. It is employed in home heating systems.
   c. It is used in air-conditioning systems.
   d. It is used to operate automobiles, motorcycles, trucks, buses, power lawn mowers, farm machinery, and air compressors.
   e. It warms the atmosphere.
   f. It warms surface waters of lakes, ponds, and rivers.

3. Have students determine some basic energy sources available in the environment and to what extent they are convertible. For example:

   a. sunlight—may be converted to electricity by means of solar cells
   b. moving water—rapidly moving water drives hydroelectric plants to produce electrical energy and tidal flow can drive tidal generators to produce electricity
   c. wood—burned to produce heat energy or wood converted to charcoal and burned for heat energy
   d. coal—burned to produce heat energy or coal burned to produce heat which converts water to steam and drives equipment which generates electrical energy
   e. oil—burned to produce heat energy or oil burned to produce heat which converts water to steam and drives equipment which generates electrical energy
   f. natural gas—burned to produce heat
   g. liquified petroleum products—burned to produce heat

h. nuclear energy—used to produce heat which converts water to steam to drive equipment which generates electrical energy
i. gasoline—a crude oil derivative burned to produce heat

4. Examine each of the energy sources identified above and assess them in terms of their advantages and disadvantages in environmental terms. For example:

| *Energy Source* | *Advantages* | *Disadvantages* |
|---|---|---|
| a. solar energy | virtually undepletable<br>nonpolluting | requires very large areas for heating water or generating electricity by means of solar cells, not always available because of clouds |
| b. moving water | available for long periods into the future | limited availability in terms of quantity and location |
| c. wood | a renewable resource | use as fuel competes with other uses,<br>not uniformly distributed,<br>incomplete combusion products contribute to atmospheric pollution |

B. *Question*

In what ways does energy in the environment affect people?

*Suggested Procedure*

1. Have students study the potential energy of foods to determine:
   a. If people receive adequate amounts of food. If not, determine the consequences of inadequate food (in terms of energy requirements of humans).
   b. The factors in his environment which influence the amount and kinds of of food he consumes.
   c. Some foods, carbohydrates, and fats that have higher energy potentials than other foods and the advisability of limiting one's diet to only those foods with the highest energy potential.
   d. If all the energy were released from all of the food one consumes, what might become of any unexpended energy.
   e. What becomes of the heat produced by the body through normal human activities.
   f. What becomes of other products of energy transformation in the human body (e.g., carbon dioxide and water).

2. Have the student make a list of all of his activities which require energy. For example:
   a. generally—sunlight and food
   b. in school—heating, air conditioning, office machines, kitchen appliances, floor buffers, lighting, clocks, and bells
   c. at home—heating, air conditioning, lighting appliances, power tools, radio, television, and clocks
   d. in the community—street lighting, cars, autos, trucks, buses, street-cleaning equipment, heating & air conditioning in buildings, electric utilities, and telephone service

3. Have the students survey the various energy-requiring devices in their homes (use safety precautions) to determine:

   a. which requires the greatest amount of energy
   b. which requires the least amount of energy
   c. which is the most expensive to operate
   d. those essential for survival (your ability to continue living), and improvement in the quality of your life

4. Have the students interview their grandparents or other older members of their community to get some insight into energy use patterns thirty, forty, and fifty years ago to determine:

   a. the size of the community
   b. the energy-requiring devices used by the townspeople
   c. the difference in the lifestyle
   d. the difference in the energy costs
   e. the modes of transportation and compare the energy requirements and waste products of the different modes of transportation with energy requirements and waste products of the different modes of transportation today
   f. the extent of the concern for pollution and environmental degradation
   g. the ways the lifestyle of the person being interviewed have changed between his childhood and the present and the rate of its occurrence

5. Have the student determine the extent energy-related activities in the environment have had an aesthetic impact on him. For example:
   a. utility poles
   b. different types of smoke billowing from power plant stacks
   c. truck and bus exhaust fumes
   d. a lake (reservoir) behind a hydroelectric dam
   e. radiators and heat vents in your home

6. Have the students determine the years' cost and the percentage of the total family income of financing various energy-related activities. Include:

   a. cost and efficiency of heating fuel
   b. cost and efficiency of electricity
   c. cost and efficiency of automobile fuel
   d. cost of energy requiring appliances (divided by the number of years of anticipated usefulness)
   e. cost and efficiency of firewood for the fireplace
   f. cost and efficiency of various food

7. Have the students determine the extent energy-consuming activities contribute to the degradation of the environment. For example:

   a. heated effluent from power plants killing fish
   b. exhaust gases from internal combustion engines polluting the atmosphere
   c. smoke from industrial operations polluting the atmosphere
   d. certain strip mining operations destroying the lands
   e. oil-carrying ships spilling oil

8. Have the students determine the economic impact of the effects identified in the previous activity.

C. In what ways do people affect energy in the environment?

*Suggested Procedure*

1. Have the students read and react to the following statements:
   a. Generally, the heavier an automobile or truck the poorer its gas mileage.
   b. It costs more to travel a particular distance in a heavier rather than a lighter automobile or truck.
   c. The volume of pollutants produced during such a trip is generally greater with the heavier vehicle.
   d. Most people prefer larger, heavier cars.
2. Have student:
   a. Identify and explain the energy-related advantages of riding a bicycle compared with driving a car when making a short trip.
   b. Determine why many people prefer to drive a car even when a trip is not particularly demanding by bicycle.
3. Have student determine:
   a. the number of cars in the school parking lot which belong to faculty, administrators, and other school personnel
   b. the number of faculty, administrators and other personnel
   c. the average number of riders per car
   d. a method of increasing the average number of riders per car so the use of fuel could be reduced
   e. if there are other factors that should be considered
4. Have student:
   a. Keep careful records for a week to determine the number of hours lights are on in the school when they are not needed.
   b. Suggest ways to avoid wasting electricity used with unnecessary lighting.
5. Generally speaking, the faster an automobile is driven, the more fuel it requires to go a particular distance. Have students:
   a. Discuss the reasons why people often travel at high speeds when they could save fuel by going more slowly.
   b. Determine ways to reduce the speeds of moving automobiles. For example:
      (1) manufacture cars with "governors" which prevent them from going faster than 50 miles per hour
      (2) hire more law enforcement officers to enforce lowered speed limits
      (3) post signs which indicate a maximum legal speed of 50 MPH
      (4) encourage people to "report" anyone observed exceeding a speed of 50 miles per hour
   c. Determine the advantages and disadvantages of each of the previous suggestions.
6. Have student:
   a. Scrutinize the various energy-requiring activities which occur in his home to determine if all are essential.
   b. Suggest changes in energy use patterns in his home to lower the energy requirements.

c. Suggest problems he might encounter in instituting energy conserving practices in his home.

7. Have students determine:

   a. those laws affecting the energy-requiring activities in his community
   b. who makes these laws
   c. in what ways residents of the community influence the creation of these laws
   d. if we should guarantee the rights of each citizen to his opinions and set of values

## INVESTIGATION ELEVEN: TRANSPORTATION AND THE ENVIRONMENT

### Goals and Objectives

The goal of this investigation is to involve students in interpreting human transportation activities and the relationships between people and transportation. During the investigation, students will:

1. Determine the nature and role of transportation activities.
2. Recognize choices in satisfying transportation needs.
3. Determine the nature and extent of their community highway system and the factors which influenced its development.
4. Identify the effects of various types of conveyance and transportation activities on the environment.
5. Determine transportation needs for family activities.
6. Determine the cost of different forms of transportation.
7. Identify the limits of and public reaction to mass transit.
8. Determine the impact community growth has on transportation activities.
9. Determine how people reduce the harmful effects of transportation activities by changing their transportation patterns.

### Questions:

A. What is the nature and role of transportation in the community?
B. How does transportation affect people in the community?
C. How do people affect transportation in the community?

### Conducting the Investigation

A. *Question*

What is the nature and role of transportation in the community?

*Suggested Procedure*

1. Have students identify different forms of transportation used in the community and the principal functions performed by each. For example:

   a. walking—transports individuals and small numbers of relatively small objects
   b. bicycles—transport one or two people and small objects
   c. automobiles—transport one to several people, relatively small objects, and small quantities of objects
   d. trucks—transport large and/or heavy objects or large quantities of objects
   e. buses—transport large numbers of people and small quantities of objects
   f. trains—transport large numbers of people, large objects, and/or large quantities of objects

2. Have student identify a variety of human activities and indicate the type of transportation needed for each activity.

   a. shopping at nearby market—walking, bicycle, auto
   b. shopping at remote market—bicycle, automobile
   c. going to nearby school—walking, bicycle, automobile
   d. going to remote school—bicycle, automobile, bus
   e. moving goods from warehouse to retail stores—trucks
   f. going to work—walking, bicycle, automobile, bus
   g. attending church—walking, bicycle, automobile

3. Have students determine factors which justify the particular choice one makes when more than one mode of transportation is available. For example:

   a. distance to destination
   b. time required by various means versus time available
   c. number of people and/or objects involved
   d. habit
   e. hazards along route or heavy traffic
   f. accessibility of alternatives

4. Have students discuss their findings in the previous activity and draw tentative conclusions concerning:

   a. the relationship between transportation needs and the form of transportation which appears to satisfy those needs
   b. the transportation choices individuals make from the options available to them in relationship to other possible choices that would be less damaging to the environment

B. *Question*

How does transportation affect people in the community?

*Suggested Procedure*

1. Have students form teams to consult the community highway department or traffic engineer to determine:

   a. the growth of the community highway system (Consult maps of the community prepared five, ten, and fifteen years in the past.)
   b. events in the community which relate to the rate and pattern of highway development. For example:
      (1) population growth
      (2) the pattern of residential growth
      (3) the establishment of shopping centers
      (4) introduction of new industries
      (5) construction of new bridges
   c. the portion of the tax dollar allocated to highway construction and related activities (bridge building and traffic control)

2. Have students form teams to interview members of the Air Pollution Control Board to determine:

   a. the nature of pollutants discharged in the exhaust from vehicles operated by internal combustion engines (autos, buses, and trucks)

b. long term changes in the level of pollutants in the air
c. factors relating to the type of vehicle and the discharge of pollutants into the air

3. Have students form teams and consult local health authorities to determine:

   a. the long-term pattern of respiratory disease and other diseases in the community
   b. the relationship between these data and the change in pollutants in the air
   c. the relationship between the increase or decrease in respiratory disease and the increase or decease in other diseases

4. Have students interview residents of the community who have made the trip from home to work and back, between the same two points, for a period of years to determine:

   a. any changes in the time it has taken to make the trip
   b. any changes in the route(s) taken by the individuals
   c. any reactions as a result of changes in route(s)

5. Have students pool information and summarize the environmental degradation effects of highway development, with its related increased numbers of cars, buses, and trucks, in terms of:

   a. air pollution levels
   b. noise levels
   c. aesthetic effects
   d. increased taxes
   e. ability of the land surface to absorb rain and melted snow
   f. role of the central community in the activities of the total community

6. Have students identify the scope of their travel by bicycle and the factors which determine the nature and extent of bicycle use. For example:

   a. distance
   b. traffic hazards along route
   c. availability of alternative forms of transportation
   d. transportation requirements

7. Have student make a survey of the number of students who come from families with two or more automobiles and why they feel the need of the additional transportation vehicles? For example:

   a. tendency for fewer activities involving the entire family
   b. daytime activities requiring automobile transportation while father had the "family car" at work
   c. compact second car saves on fuel expenses for certain kinds of trips where large family car is not necessary

8. Have student:

   a. consult his parents to determine the cost to the family of transportation over a period of five to ten years
   b. determine changes in absolute costs and percentage of "absolute" costs relative to that portion of the family budget devoted to transportation

*Suggested Procedure*

1. Have the students identify energy sources and materials used in the school and estimate the daily per capita use rates of each. For example:

   a. Land—

      (1) determine total acreage of school grounds.
      (2) determine percentage amounts of land devoted to buildings, parking lots, playgrounds, athletic fields, tennis courts, lawn, forest
      (3) determine condition of the land prior to the building of the school and modifications to it during the life of the school

   b. Building materials—

      (1) determine the different kinds of materials employed in the construction of the school and school grounds
      (2) determine the quantities of each material used in the construction of the school (Note: Blueprints and other information pertaining to the construction of the school are probably on file in the school superintendent's office.)
      (3) determine the cost of the original school construction based on current costs of materials and labor

   c. Water—

      (1) contact the community water department to determine the daily consumption rate for the school
      (2) estimate the portion of the total water consumption employed in various activities in the school

   d. Food—

      (1) discuss with cafeteria personnel the amounts and kinds of food consumed each day
      (2) determine the amount of food consumed by students who bring their lunches
      (3) determine total daily food consumption
      (4) estimate the total cost including space requirements and equipment over a period of twenty years

   e. Paper—

      (1) determine the paper use patterns (e.g., dittoed and mimeographed sheets, notebook paper, and graph paper)
      (2) determine specialized paper uses (e.g., paper for mechanical drawing, art work, and office supplies)
      (3) determine other uses of paper
      (4) determine total daily paper consumption
      (5) determine the percentage of paper that is used only on one side

   f. Chemical compounds—

      (1) determine the amount of duplicator fluid used
      (2) determine the amount of detergents and other cleaning agents used
      (3) determine the amount of paint used in art classes, and for maintenance purposes
      (4) determine amounts of other chemical compounds used



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(5) estimate the total daily quantity of various chemical compounds
(6) determine the flow pattern of these agents

g. Sources of energy—
(1) determine the amount of fuel oil, coal, and gas used
(2) determine the amount of electricity used
(3) determine other sources of energy and the amounts used
(4) determine the total energy demands made on a daily basis

B. *Question*

What types and amounts of wastes are produced in the school and what do we do with these wastes?

*Suggested Procedure*

1. Have the student identify the different kinds of wastes produced during the normal operation of the school and discuss their findings. For example:
   a. sewage
   b. solid wastes
   c. smoke from heating plant
   d. heat
   e. waste water
   f. automobile and bus exhaust
2. Have students form teams to investigate the amounts of waste produced in each of the categories in the previous investigation and establish the flow pattern of these wastes.
3. Have students determine the extent of the school's contribution to the community waste treatment facilities.
4. Have students identify untreated wastes resulting from the operation of the school.

C. *Question*

Are there ways we can modify our use of energy and materials in the school without impairing the school's normal functions?

*Suggested Procedure*

1. Have the students suggest a plan for reducing the production of wastes by:
   a. reducing the use of materials which contribute to waste production
   b. making better use of materials which produce wastes
   c. increasing the efficiency of energy use
2. Have students study the evidence found in the school use patterns and make recommendations for changes. For example:
   a. diminish paper use by increased use of chalkboard, intercom and overhead projector
   b. use both sides of paper
   c. regulate time for showering
   d. turn off room lights except when absolutely necessary
   e. repair dripping faucets

3. Have students discuss the following issues:

   a. If it were decided to regulate the use of various environmental factors in the school, should teachers follow the same procedures as students or upperclassmen the same rules as underclassmen?
   b. If greater economies could be achieved in the operation of the school and a budget surplus resulted, how should the extra money be spent?
   c. If substantial savings in electricity could be achieved by starting the school day an hour earlier, would you recommend this change in the daily schedule? Why? Why not?

## INVESTIGATION THIRTEEN: LITTER

### Goals and Objectives

The goals of this investigation are to have the students critically examine the concept of litter, recognize the legal, economic, and social aspects of it, and examine ways of coping with litter problems. Students will:

1. Develop a comprehensive definition of litter.
2. Determine the nature and extent of littering activity in the community.
3. Determine the composition of litter.
4. Relate patterns of littering to other activities of people.
5. Determine local, state, and national laws which relate to littering.
6. Identify community agencies with anti-litter activities and determine their effectiveness.
7. Determine the cost of litter removal to the community.
8. Examine recycling as a means of coping with litter problems.
9. Study the habits and attitudes of people responsible for littering in order to identify the reasons behind the littering problem.
10. Make decisions concerning the problem of littering, its causes, and some possible solutions.

### Questions:

A. What is litter and where is it found in the community?
B. What laws and community agencies operate to regulate "littering activity"?
C. How might materials discarded as litter be retrieved and used?
D. Why do people litter?

### Conducting the Investigation

A. *Question*

What is litter and where is it found in the community?

*Suggested Procedure*

1. Have students develop a comprehensive definition of litter which is acceptable to most students. (Note: In addition to human refuse, the term litter also refers to partially decomposed organic material on the forest floor, animal excreta, leaf litter, and other materials used for mulching.)
2. Have students form teams to survey the community and determine:

   a. the nature of materials which comprise litter
   b. the pattern of distribution of litter in the community

3. Have students examine samples of litter which have been brought in and determine:

a. the basic materials of which litter is composed (e.g., paper, plastic, metal, and food remains)
b. the origin of the different materials (e.g., various types of containers, discarded furniture, and food wrappers)

4. Have students use a map of the community to:

   a. plot the distribution of litter
   b. develop a code employing different colors and different patterns of cross-hatching to distinguish areas of light, moderate, and heavy littering
   c. determine characteristics of the areas which might account for patterns of light, moderate, and heavy littering—for example:

      (1) the amount of automobile traffic
      (2) proximity of residences
      (3) activities of street cleaning agencies
      (4) availability of trash barrels

5. Have students determine tentative conclusions that may be drawn from the information gathered in the preceding investigation concerning:

   a. the nature of materials discarded in the form of litter
   b. the littering "habits" of people
   c. possible ways of diminishing the littering activity of people

B. *Question*

What laws and community agencies operate to regulate littering activity?

*Suggested Procedure*

1. Have students form groups to interview various representatives of the local law enforcement agency and determine:

   a. local, state, and national laws which pertain to littering
   b. enforcement activities related to these laws
   c. attitudes of law enforcement officers toward these laws and their enforcement
   d. the cost of enforcing these laws

2. Have students form groups to interview agencies responsible for cleaning up litter in the community and determine:

   a. the adequacy of the number of men and the equipment employed to remove litter
   b. the destiny of the litter which is collected
   c. the attitudes of litter removal workers toward the littering activities of people
   d. the cost of litter removal to the community

3. Have sudents discuss their findings and draw tentative conclusions from the information gathered in this investigation concerning:

   a. the effectiveness of current litter clean-up activities
   b. the effectiveness of community litter removal agencies
   c. the effectiveness of laws in diminishing the tendency of people to litter
   d. the cost to the community of law enforcement and litter removal activities

C. *Question*

How might material discarded as litter be retrieved and used?

*Suggested Procedure*

1. Have students identify the basic problem encountered in efforts to recycle materials in litter (i.e., litter consists of a heterogeneous mixture of materials which must be sorted before individual materials may be recycled).
2. Have students suggest a method for separating a heterogeneous mixture of either.
3. Have students form groups to identify recycling operations in the community accepting sorted materials (e.g., paper and metal recycling projects of citizen's groups; scrap paper and metal salvage companies) and interview officials to determine:
   a. their perception of the communities commitment to recycling materials
   b. if materials sorted from litter might be salable at a profit
4. Have students draw tentative conclusions from the information gathered concerning:
   a. the feasibility of retrieving materials from litter for recycling
   b. a cost-benefit analysis of recycling materials from litter

D. *Question*

Why do people litter?

*Suggested Procedure*

1. Have teams of students identify the group or groups of people responsible for most of the littering in the community and determine:
   a. if any particular age group seems more responsible for littering than any other (e.g., young children, teenagers, adults)
   b. if there are any apparent socioeconomic characteristics of litterers (e.g., do they tend to seem poor, of moderate means, or wealthy?)
   c. any other characteristics which seem to be common among litterers
2. Have students interview a number of people to determine their attitudes toward:
   a. littering in general
   b. effectiveness of removing litter in the community
   c. recycling activities in the community
   d. individual's responsibility to the community for littering and waste removal
3. Have students discuss their findings and draw tentative conclusions concerning:
   a. the reason why people litter
   b. some changes necessary to diminish littering practices of people. For example:
      (1) improving trash pick-up services
      (2) packaging practices which would diminish the need to dispose of packaging materials
      (3) providing more litter barrels
      (4) stricter enforcement of anti-litter laws

4. Have the students form positive and negative teams to debate the following questions:

   a. Is all litter undesirable?
   b. Is littering really a problem? Is the visual blight so unattractive that the expense of cleaning it up is worthwhile?
   c. If more stringent anti-litter laws were passed would people be likely to obey them all of the time?
   d. Since so many people seem oblivious to the litter problem, are you willing to pick up after them?
   e. If the only way that litter problems can be solved is through higher taxes, are you willing to contribute your own money to assist your parents in paying higher taxes?
   f. Why is littering a problem in the classroom or in the school?

## INVESTIGATION FOURTEEN: IDENTIFYING A FIELD ENVIRONMENT

**Goals and Objectives**

The goals of this investigation are to help students develop a concept of fields which reflect agricultural, recreational, legal, aesthetic, and other aspects of these features of the landscape. The ways in which fields affect people and are affected by people's activities are explored. Students will:

1. Determine the nature and scope of the concept of a field.
2. Determine characteristics of various types of fields
3. Determine ways fields, and the activities related to them, have economic influences on people.
4. Determine the aesthetic impact of fields on people in the community.
5. Identify the role of fields in providing recreational opportunities for members of the community.
6. Relate human activities occurring in fields to noise levels in the community.
7. Identify laws regulating the uses of fields.
8. Identify community agencies which regulate and/or enforce restraints on the uses of fields in the community.
9. Determine the relationship between location, function, and the cost of land occupied by various kinds of fields.
10. Evaluate alternative decisions concerning regulating the uses of fields in a community.

**Questions:**

A. What is a field and how do fields vary?
B. How do fields affect people?
C. How do people affect fields?

**Conducting the Investigation**

A. *Question*

What is a field and how do fields vary?

*Suggested Procedure*

1. Have students form teams to survey the community to identify fields (e.g., playing fields, parking lots, fields where crops are raised, fields used for grazing livestock, and vacant lots) and determine the common characteristics shared by the fields.

2. Have students discuss their findings in terms of the following characteristics:

   a. Are there topographic similarities?
   b. Do fields contain man-made structures?
   c. All fields exhibit planned uses.
   d. Are fields the habitat of plants and animals other than humans? (Detailed answers to these questions may require field investigations including sampling and collecting decisions, and practice in plant and animal identification.)
   e. Do the nature and use of fields change through time? (Note: Examination of topographic maps and/or aerial photographs taken at different times may help in answering this question.)
   f. How do physical factors such as temperature, moisture and prevailing winds influence the character of a field?
   g. Are there seasonal variations in the composition of fields?

3. Have the students plot the locations of the various fields identified on a map and determine:
   a. where most of the identified fields are located relative to the central community
   b. if there is any relationship between the use of a field and its location in the community

B. *Question*

How do fields affect people?

*Suggested Procedure*

1. Have students classify the fields according to the following principle uses:

   a. agriculture
   b. recreation
   c. "non-planned-use"

2. Have students form teams to interview farmers and townspeople to determine:

   a. the farmers influence in the local economy through:

      (1) selling products for local consumption
      (2) selling products to remote markets
      (3) purchasing materials and equipment (seed, fertilizer, and farm equipment) from local merchants
      (4) employment of local residents on the farms
      (5) payment of taxes to the local community

   b. the extent farms adjacent to the local community are being viewed as real estate development potential
   c. the aesthetic impact of agricultural fields in the countryside surrounding a community
   d. the ways privately owned farm land influences highway construction activities
   e. the extent farming activities in fields contribute to noise in the community

3. Have students form teams to interview park directors, school officials, and other townspeople to determine:

a. the number of people in the community benefiting from recreational fields
b. age groups getting the most use from recreational fields
c. how recreational fields are financed
d. the community agencies deciding when and where a new recreational field will be created and how individuals can influence these decisions
e. the cost of vandalism and other misuse of recreational fields to the community
f. the aesthetic effect of recreational fields on people
g. the impact of recreational fields on noise levels
h. the percentage of the population viewing recreational fields in positive terms

4. Have students investigate ways "non-planned-use" fields influence people by interviewing people who live near such fields to determine:

a. their attitudes toward the vacant lot
b. the extent these fields serve as informal play areas for children who live near them
c. who pays taxes on the fields

C. *Question*

How do people affect fields?

*Suggested Procedure*

1. Have the students determine the following information about agricultural fields:

a. the steps farmers take to insure continued productivity
b. the extent changes in the markets for agricultural products influence the use of the fields
c. the extent cost of labor, seed, feed, fertilizer, and equipment influence use of the fields
d. the extent legislation (e.g., farm price support and pollution abatement laws) influences use of the fields
e. the extent technology (e.g., new seed varieties, improved pesticides, and new types of farm equipment) influences use of the fields
f. the extent population growth in nearby communities influences use of the fields

2. Have the students determine the following information about recreational fields:

a. the community agencies charged with the responsibility of planning, developing, and maintaining recreational fields
b. ways members of the community can influence recreational field development
c. the effects of population growth on recreational field facilities
d. the difficulty in hiring personnel to staff the recreational fields
e. the extent vandalism has increased the maintenance cost and curtailed use of the recreational fields

3. Have the students determine the following about fields with "non-planned-use":

a. the lack of interest in developing the fields for recreation or housing
b. the classification of these fields according to community zoning codes
c. the plans for future development of these fields

4. Have the students use their maps to plot the location of various fields, to determine:

   a. the relationship between the location of a field and the price of land in the area
   b. the fields considered most likely for real estate development in the near future and why
   c. the relationship between field location and the zoning classifications of the area

5. Have the students form positive and negative teams to debate the issues revealed by the following questions:

   a. To what extent should the use of a field be the decision of:

      (1) the person who owns the property
      (2) the residents of the community in which the property is located

   b. Should land zoning decisions be based on the concerns of:

      (1) the people who live immediately adjacent to the area in question
      (2) the person who owns the land
      (3) a community agency
      (4) a vote by the entire community

   c. Which is the most important use of fields:

      (1) a place where plants and wildlife may flourish undisturbed by people
      (2) a place where recreational needs may be satisfied
      (3) a place which, by it's naturalness, will enhance the aesthetic qualities of the environment
      (4) a place where needed agricultural products may be produced
      (5) a place where man-made structures should be built to benefit masses of people

## INVESTIGATION FIFTEEN: SOLID WASTES

### Goals and Objectives

The goals of this investigation are to help students interpret the concept of solid wastes, the environmental impact of solid waste production, and the disposal of wastes. Students will:

1. Develop a definition of the concept of solid wastes.
2. Identify the sources of solid wastes.
3. Determine the composition of solid wastes.
4. Identify the methods of disposing of wastes in the community.
5. Identify materials viewed as wastes under some circumstances and useful under others.
6. Determine the accumulated effects of clean-up type waste disposal on the community.
7. Examine the role legislation may play in affecting solid wastes production and disposal.
8. Examine the economic impact on the community of solid waste production and disposal.
9. Determine the role people's attitudes and behavior play in the production of solid wastes.
10. Determine the role recycling activities play in the production and disposal of solid wastes.
11. Examine their own values as they relate to the production and disposal of solid wastes.

**Questions:**

A. What are solid wastes and how are they disposed?
B. How do solid wastes affect people?
C. How do people affect solid wastes?

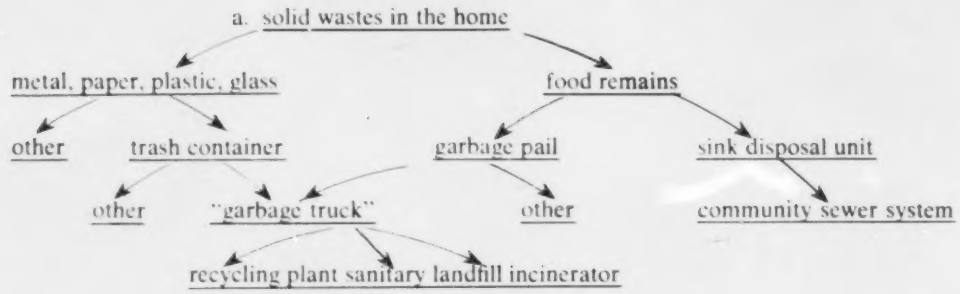
**Conducting the Investigation**

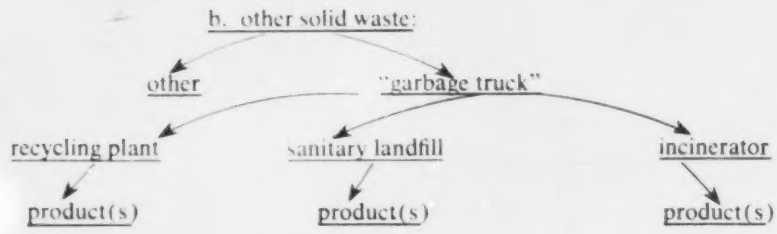
A. *Question*

What are solid wastes and how are they disposed?

*Suggested Procedure*

1. Have students keep careful records of the amount and kinds of solid materials they dispose of during normal living activities. For example:
   a. food wrappers
   b. boxes
   c. cans
   d. bottles
   e. food remains
2. Have students make a survey of the community to identify solid wastes other than those indicated above. For example:
   a. "junk" automobiles
   b. rubble from demolished buildings
   c. highway litter
   d. fallen leaves
   e. dead trees
   f. lawn clippings
3. Trace the disposal pattern of solid wastes originating in different locations in the community. For example:



4. Have students design and label flow charts similar to 3a and 3b as biodegradable solid waste and non-biodegradable solid waste.
5. Have students form teams to visit sanitary landfills to observe the operation and to interview local officials associated with the facility in order to collect such information as:

   a. the basic requirements for the siting and operation of the landfill—for example:

      (1) suitable topography
      (2) availability of "fill" material
      (3) earth-moving equipment
      (4) access roads

   b. the successive annual rates at which the site is being filled
   c. the problems in acquiring sanitary landfill sites—for example:

      (1) cost of land
      (2) reaction of people living near proposed sites
      (3) topographic considerations
      (4) distance of proposed sites from the community

   d. the potentially useful materials that become inaccessible when deposited in a sanitary landfill. (e.g., glass, paper, and metal)

6. Have the students discuss their findings and draw tentative conclusions from the information gathered in the previous activities—for example:

   a. Define the term solid wastes in terms of:

      (1) the materials of which it is composed
      (2) use patterns of people
      (3) the destiny of the materials

   b. the ways in which materials identified as wastes might be considered useful. For example:

      (1) feeding food remains to animals
      (2) reusing boxes for other purposes
      (3) using building rubble for road building
      (4) using leaves and lawn clippings in compost heaps

   c. ways the volume of solid wastes deposited in local sanitary landfill can be reduced. For example:

      (1) sorting solid wastes to isolate recyclable materials
      (2) reusing materials usually discarded after one use
      (3) use of home waste compactors

   d. Have students determine why the siting and operation of sanitary landfills is considered to be a problem. For example:

      (1) population growth in communities has led to more people producing more wastes
      (2) there has been a trend toward the creation of throw-away items for household consumption

(3) increased affluence coupled with low-cost, mass-produced items has led to easy replacement of items and less concern for saving and reusing them
(4) community growth and increased land values have made it difficult to acquire landfill sites close to the community
(5) increased demand on landfill sites has decreased the half-life of land fills

B. *Question*

How do solid wastes affect people?

*Suggested Procedure*

1. Have students form teams to interview appropriate representatives of community agencies to determine:
   a. the number of people employed by the community in activities associated with solid waste disposal
   b. the percentage of solid waste that might be recovered if a recycling plant were operating in the community
   c. financial benefits of a recycling plant (i.e., profits from sale of retrieved material—capital investment in recycling plant depreciated over estimated life of plant—operating costs)
   d. people's reactions to the aesthetic properties of sanitary pollution in the community
   e. extent "garbage trucks" contribute to air pollution in the community
2. Have students form teams to conduct a survey to determine how many people believe:
   a. current methods of disposing of solid wastes are acceptable
   b. new procedures are needed for disposing of solid wastes
3. Have the students discuss the following questions:
   a. Who bears the greatest responsibility for the problems associated with solid waste production and disposal?
      (1) the consumer
      (2) the packaging industry
      (3) local governmental agencies
      (4) science and technology
   b. Which of the following practices should be adopted? Why, or why not?
      (1) using only returnable containers
      (2) buying only the largest quantity of a product that is available
      (3) washing and reusing containers rather than disposing of them
      (4) taking your own shopping bag to the supermarket to avoid the need for paper bags supplied by the market

C. *Question*

How do people affect solid wastes?

*Suggested Procedure*

1. Have the students determine if it takes more packaging material to package a quantity of material in two or more packages than it takes to package the same volume of material in one package.
2. Have the students determine whether:
   a. people purchase materials in the largest volume package
   b. there are savings in purchasing the large economy size
3. Have the students determine how it would affect the community if a law banning the sale of beverages in disposable containers were to be passed in their community. For example:
   a. interview representatives of local bottlers, wholesalers, and retailers of beverages to determine their reaction to such a law
   b. determine the number of bottles and cans of soft drinks sold in the community in an average month
   c. determine the average monthly number of reusable containers that would have to be returned
   d. determine the number of reusable containers to be returned by each individual each month
   e. interview people to determine their attitudes toward reusable soft drink containers
4. Milk used to be sold in reusable glass containers. Have students determine the affects of restoring this practice on:
   a. the volume of solid wastes produced by the community
   b. the use of drinking water for cleaning the milk bottles
   c. the milk packaging industry
5. Have students identify ways he may reduce the amount of biodegradable material picked up from his home.

## INVESTIGATION SIXTEEN: INVESTIGATING LAND-USE PATTERNS IN THE COMMUNITY

**Goals and Objectives**

The goals of this investigation are to help students interpret the uses for land in their community, the factors which regulate its use, and the need for planning community growth. Students will:

1. Survey their community to identify land uses.
2. Identify land-use patterns on a map of the community.
3. Identify relationships between factors in the community and their effects on land-use patterns.
4. Examine maps to identify land-use trends.
5. Relate the regulatory functions of zoning agencies, law enforcement officials and land-use problems.
6. Determine the function of a community planning commission and the methods it uses in planning for the future growth.
7. Consider the relationships among community characteristics and long-term planning in the community.
8. Determine the role of the resident in long-term community planning.

**Questions:**

A. What uses are made of land areas in the community?
B. What characteristics determine land-use patterns in the community?
C. In what ways is land use regulated?

**Conducting the Investigation**

A. *Question*

What uses are made of land areas in the community?

*Suggested Procedure*

1. Have the students survey the community to determine different land uses. For example:

   a. residential (single and/or multiple dwellings)
   b. recreational (parks, playing fields, golf courses, and playgrounds)
   c. industrial (light and heavy industries)
   d. commercial (stores, filling stations, and banks)
   e. institutional (schools, colleges, and hospitals)
   f. governmental (city hall, courthouse, and post office)
   g. "unused" (vacant lots and wooded areas)

2. On a map of the community, have the students identify land-use patterns by means of a color code designating the various land-use classifications as previously identified. If any areas cannot be classified in terms of decisions made in step 1, create additional categories to accommodate these areas.

B. *Question*

What characteristics determine land use patterns in the community?

*Suggested Procedure*

1. Have students seek relationships between various land uses and other characteristics of the community. For example:

   a. Do land uses relate to transportation services (rail lines, bus routes, and highway patterns) in the community?
   b. Does topography influence land use in the community?
   c. Do water bodies (lakes, rivers, streams) influence land use in the community?
   d. Is there any relationship between the location of schools and the distribution of residential areas in the community?
   e. Is there a relationship between the location of shopping centers and the distribution of residential areas in the community?
   f. What features of the community relate most to the locations of service stations?
   g. Are industrial operations concentrated or dispersed in the community? Why?
   h. Is there a relationship between land costs and location in the community?
   i. Is there evidence that former uses of land are being replaced by new uses (e.g., historical landmarks being demolished and former central community residential areas being converted to commercial use)?

2. Have the students examine maps of the community from five, ten, and twenty years ago to determine:

   a. the pattern of community growth and factors which have influenced this pattern
   b. changes in the economic base of the community which may account for growth spurts
   c. indications of changing values among residents of the community (e.g., changes in what are considered to be residential areas, and greater willingness to live farther from the center of the community)
   d. features of the community which appear to have been lost as a result of community growth (e.g., historical landmarks and community parks)
   e. if comparisons of former conditions of the community with present conditions suggest ways for predicting future growth patterns of the community

C. *Question*

In what ways is land-use regulated?

*Suggested Procedure*

1. Have the students form teams to interview members of the community zoning board and law enforcement agencies to determine their roles in regulating land-use in the community. Students should be aware of the nature of private property and the rights and responsibilities of citizens in their use of private property. A review of the "nature of private property" would establish a framework for this investigation. From this information, have the students pursue the following questions:

   a. Can the owner of property in a residential section of the community build a "hamburger stand" and go into business simply because he owns the property in question?
   b. If your neighbor builds a swimming pool on his property and you believe it is a dangerous situation for young children in the neighborhood, is there any way you can influence this use of private land?
   c. A man owns property in the community and learns that a developer has bought property adjacent to his and is planning to build multiple-dwelling housing units on it. He believes that this will lower the value of his property. Can he legally affect the developer's plans?
   d. A particularly favorable location for a new school is found to be zoned for residential purposes. Can the land be rezoned in order to permit the construction of a school?
   e. A farmer whose land borders the community raises pigs. Residents who live downwind from the pig farm are offended by the sights and smells associated with the farm. Can they influence the farmer's use of his land?
   f. A homeowner paid a premium for his lot because it offered a spectacular view of a nearby mountain range. Recently, construction was started on a multi-story motel which, when completed, will obscure his view of the mountains. Can he legally influence the use of the land in question?
   g. A couple with young children chose the location of their home because it was on a dead-end street. Recently their street was extended to meet with a major highway and has become a popular shortcut for many motorists.

The neighborhood has become much noisier and very dangerous for young children. Can the residents of this area influence the use to which the land was put?

h. A high school student has learned that a large open field on the edge of town is going to be paved over to accomodate a large shopping center and to provide a parking area for it. He fears that the water-absorbing properties of the soil in this field are necessary to avoid dangerous flooding in the area after heavy rains. Can he influence this situation?

i. The new owner of a large home, in a neighborhood characterized by large homes built many years earlier and now somewhat poorly kept, decides to divide his home into apartments to be rented to students at a nearby college. The other residents of the neighborhood, many of whom are retired, fear that the influx of college students will disturb their quiet block. Can they influence the man who is planning the apartments through recourse to local agencies?

j. The person who lives next to you is gone much of the time and does not seem interested in maintaining his house and property like the other neighbors. The paint on the house is peeling, windows are broken, the lawn is uncut, and two old cars are located in the driveway. Can one influence this use of private land?

k. The state highway division has purchased a number of house lots in a section of the community where a new highway is to be built. One resident of this area does not wish to sell his land, even though the price is a fair one, and refuses to accept the state offer for the property. Who has the legal right to determine the use of the land—the individual or the state?

2. Have students interview members of the local planning agency to determine their function and relationship to other agencies whose responsibilities relate to land-use and to determine answers to the following questions:

   a. How long has the planning agency been in existence? Why was it created and what has its primary function been to date?

   b. What characteristics of a community are considered to be important planning parameters? For example:

      (1) physiographic conditions
      (2) soil associations
      (3) public utilities
      (4) public facilities and services
      (5) industrial activity
      (6) natural resources
      (7) land-use patterns
      (8) existing zoning

   c. In making planning decisions, trend data are employed. What types of trends have been studied by the planning commission? For example:

      (1) population trends
      (2) employment trends
      (3) labor supply trends
      (4) income trends
      (5) retail sales trends
      (6) housing trends

(7) school enrollment trends
(8) bank asset trends

d. Using trend data, planning commissions make projections when planning areas for different times in the future. Refer to the projections for your planning area to determine:

(1) how you feel about the likely conditions in your community ten, twenty, or more years from now?
(2) if you believe these projections are realistic. (How would you make projections on a different basis if you are not satisfied with the planning commission projections?)
(3) if you see according to popular projection the need for changes in your community in order to accommodate increased numbers of people—for example:

(a) job opportunities
(b) schools
(c) stores
(d) banks
(e) homes
(f) water
(g) sewage disposal
(h) transportation

3. Examine the land-use map prepared in relation to the preceding investigations. Considering the population growth projections of the planning commission, attempt to answer the following:

a. What changes in current land-use patterns are most likely to accommodate increased population?
b. In what ways will your community's adjustment to increased population be dependent on events remote from your community? For example:

(1) increased production of food in areas remote from your community
(2) increased supplies of building materials in areas remote from your community
(3) additional doctors, lawyers and teachers, who will be trained outside your community
(4) increased electric power production

c. What factors will place a limit on the size of the population your community can support? For example:

(1) food
(2) fuel
(3) housing
(4) water
(5) electricity
(6) space

4. Have students examine the planning commission's comprehensive plan for the community and answer the following questions:

a. Do you agree with the planning criteria and objectives employed in preparing the comprehensive plan?
b. To what extent is the local government obligated to follow the suggestions in the plan?
c. If the plan is followed, will it change the life styles of residents of the community?

d. Since the plan is prepared for a limited time period, will there be any effects on future planning as a result of events which occur during the period covered by the plan?
e. In what ways did the residents of the community influence the preparation of the plan?
f. What are the alternatives of the plan?

## INVESTIGATION SEVENTEEN: INTERACTING FORCES WITHIN A COMMUNITY ECOSYSTEM

### Goals and Objectives

The goal of this investigation is to help students: interpret the interacting forces within and between micro-ecosystems and macro-ecosystems and collect and use data in concluding the best land use practices in maintaining a quality environment. Students will be involved in activities associated with:

1. Identifying basic functions or various environments.
2. Identifying ways environments are interrelated.
3. Relating factors which are common to two or more environments.
4. Distinguishing between similarities and differences in two or more environments.
5. Describing specific contributions each environment makes to society.
6. Analyzing man's use of each environment.
7. Establishing recommendations for future management of each environment.
8. Describing the ways living organisms affect soil.
9. Determining the texture, structure, temperature, pH, and color of soil.
10. Determining the best uses of specific land areas.
11. Identifying what can be done to improve the soil in one's own yard.
12. Planning and initiating an urban environmental investigation.
13. Identifying component parts and existing inter-relationships of an urban environment.
14. Identifying and suggesting solutions to local environmental problems.
15. Determining ways of affecting political decision-making processes in solving environmental problems.
16. Analyzing the cause and effect relationship of factors affecting the quality of the environment and identifying the forces necessary for improving the environment.
17. Planning for the development of an entire community.
18. Determining the best uses for a parcel of vacant land and presenting a case before a "mock" Board.

### Questions:

A. What are the interacting forces of each environment and how do they interact to establish a state of equilibrium?
B. How can man influence these forces in maintaining an acceptable environmental equilibrium?

### Conducting the Investigation

A. *Question*

What are the interactive forces of each environment and how do they interact to establish a state of equilibrium?

*Suggested Procedure*

1. Select a forest area to be studied. Identify six trees exemplary of a variety of growth patterns in the area. Obtain core samples from these trees. Obtain from some agency such as the Forest Service, 4" to 6" cross sections of the type of tree to be studied. Have students:

   a. study structure of various cross-sections to obtain evidence of the history of the tree's environment (e.g., damage by fire or severe weather)

   b. study core samples for evidence of history of the environment (e.g., age of tree and rate of growth)

   c. form teams to select samples of two trees which show different characteristics to:

      (1) compare different environmental damages

      (2) compare different growth rates

      (3) infer the causes of different damages and different growth rates

   d. visit the forest from which the core samples were taken and:

      (1) locate the tree belonging to their core sample and compare their inferences with their actual findings in the forest

      (2) infer the way the area might have looked twenty years ago

      (3) predict how the area might look twenty years from now

      (4) describe how they feel about the change they envision taking place over the forty-year period

      (5) locate a stump or rotten log for careful study to:

         (a) look for evidence of change taking place

         (b) identify any cyclic processes that may be occurring

         (c) look for evidence in change which might give clues about the past history of the area

      (6) use natural items such as rotten wood, dandelion leaves, and dandelion flowers to construct a sketch of an area they consider significant

      (7) write on their sketch:

         (a) two broad descriptive words about their area

         (b) three action words about change taking place in their area

         (c) a four or five word phrase that will describe the usefulness or value of the area

         (d) one word that suggests a comparison, an analogy, or synonym about the area

      (8) share their sketches, writings, observations, and interpretations of the area

      (9) stake out an area one meter square to:

         (a) predict what will be found in the top few centimeters

         (b) sift through the top ten centimeters and record any evidence of plant and animal life they observe

         (c) identify litter, duff, and humus and identify organisms found in each

(10) locate an area suitable for a soil profile to:

(a) determine where the soil changes color and looks
(b) determine the color and texture of each layer
(c) determine the structure, temperature, and pH of each layer
(d) construct a soil micromonolith
(e) determine the slope of the land
(f) determine the air temperature just above the soil surface and one meter above the soil surface
(g) sketch a soil profile of the area studied and label the layers according to texture and depth
(h) feel and describe litter, duff, and humus
(i) study information collected and compare it with charts exhibiting soil depth, topsoil condition, and color tables; determine what might grow in the area and compare predictions with findings in the area
(j) determine factors that contribute to soil formation
(k) locate evidence of geological change in the area
(l) determine factors that affect the uses of land
(m) use agricultural and land-use charts and other evidence in suggesting the best use of the area

(11) use the soil data collected and tables to:

(a) determine the effect of soil depth on plant growth and water storage
(b) establish a relationship between soil color and soil condition
(c) establish a relationship between soil texture and water-holding capacity
(d) identify plants likely to grow in various pH ranges and soil conditions
(e) determine the length of the growing season and establish a relationship between growth rate and soil temperature
(f) identify factors affecting the use of land for various purposes and make recommendations for use of that land area

e. design an experiment to be carried out in a portion of his yard or in discarded containers for determining the results of depositing biodegradable materials in the soil—the experiment should make use of many types of biodegradable material such as newspaper, kitchen wastes, and yard materials and be designed to measure such items as:

(1) change in soil texture
(2) change in soil porosity
(3) change in soil pH
(4) change in organisms present in soil
(5) rate of deterioration of biodegradable material

2. Display an official city or county map of an urban environment accessible for student study. Have students form teams of five or more members and let

each team stake off a small area on the map they can conveniently study. Reproduce each selected segment so that each student has a map of the area he is to study. On the large map draw boundary lines around each area selected for study. Have each team:

a. list the component parts of the environment and the things that might affect the quality of the environment in that segment. Write these in the appropriate areas on the large map.

b. develop a plan of action for investigating the segment to determine cause and effect relationships between the items listed and the environment. Plan should include instrument and design for obtaining and recording information.

c. visit their selected site to make observations and record information

d. plan a presentation of their investigation which includes what they did, how they did it, and their conclusions about the environmental condition

e. identify critical areas affecting the environmental quality of the area and make suggestions, after having heard each team's report, for meeting the future needs of the area

3. Provide students with a topographical map of the local area. Have students:

a. locate a nearby body of water for study

b. trace the origin of the body of water

c. identify the boundaries of the watershed

d. visit the area to:

(1) observe and record observations about the total stream environment

(2) collect aquatic specimens

(3) use pond life picture key to identify specimens (see Appendix)

(4) use the evidence found with respective tables giving pH ranges that support various aquatic life

(5) predict the dissolved oxygen content and pH of the stream based on the collection of living materials, a chart which gives pH ranges, a table giving the dissolved oxygen requirements for native fish and other aquatic life, and a chart indicating the temperature ranges required for certain organisms

(6) use water test kits to determine the water temperature, air temperature, dissolved oxygen count, and pH of the stream and compare results with predictions

(7) determine stream flow

(8) construct a cyclic flow chart of the interacting forces around the stream environment

(9) identify any problems that may prevent the normal cyclic interacting forces

(10) suggest ways of overcoming the existing problems which will be beneficial and acceptable to man

4. After an in-depth study of the various environments represented in the previous activities, have students:

a. analyze the data collected for each environment and distinguish between similarities and non-similarities of the environments

b. identify the basic functions of each environment
c. identify the things that affect the quality of each environment
d. identify the ways each environment interacts with each other
e. summarize the unique contributions of each area to society
f. describe their feelings about man's use of each environment
g. suggest guidelines to be used in determining future land use around these environments
h. construct a flow chart to identify the energy-flow between the macro-environment, the mini-environment, and the micro-environment

B. *Question*

How can man influence these forces in maintaining an acceptable environmental equilibrium?

*Suggested Procedure*

1. Provide students with an activity for applying what they know to solve problems. The activity should consist of a series of sheets representing the topography of a land area to be studied and each subsequent sheet should supply additional information. Students should describe the area from the given information on each sheet. Suggested information for each sheet is as follows:

Sheet (1) contour lines
" (2) contour lines, three elevations, size of contour intervals, scale of kilometers, and direction
" (3) contour lines, three elevations, size of contour intervals, scale of kilometers, direction, marsh grass, pine trees, hardwood trees, and stream
" (4) contour lines, three elevations, size of contour intervals, scale of kilometers, direction, marsh grass, pine trees, hardwood trees, stream, paved roads, major highways, and railroads
" (5) contour lines, three elevations, size of contour intervals, scale of kilometers, direction, marsh grass, pine trees, hardwood trees, stream, paved roads, major highways, railroads; and symbols for parking areas, school, hospital, house, multi-family housing, recreation areas, industrial complexes, and shopping facilities

Have the students do the following activities:

a. Sheet 1:

(1) describe the design
(2) identify the bottom of the page
(3) suggest what each line represents
(4) distinguish between the high and low elevations
(5) determine the amount of elevation represented by the distance between contour lines
(6) identify the geographic directions from any point on the map

b. Sheet 2:

(1) locate the directions from any point on the map
(2) describe a "contour interval"
(3) identify the highest point on the map

(4) determine the elevation represented by the last contour line in the northwest corner of the map
(5) determine the number of square kilometers represented on the map
(6) determine the approximate distance in kilometers between two high points marked on the map
(7) determine the approximate distance between the two highest points
(8) determine, on the basis of the distance and the elevation, if the slopes are gradual or rather steep inclines
(9) make statements about other physical characteristics one might observe on an actual plot represented by this map

c. Sheet 3:

(1) determine the possibility of a stream being located where it is
(2) determine the direction the stream is flowing
(3) justify the location of the marsh grass on the map
(4) justify placing the pines on higher elevations than the hardwoods
(5) infer what animals might live in the environs as indicated
(6) infer the nature of the areas surrounding the one represented by this map

d. Sheet 4:

(1) determine the number of kilometers of highway represented on the map
(2) determine if the highway or railroad have a steep incline
(3) identify the directions of the routes of transportation

e. Sheet 5:

(1) using all the information provided by the preceding sheets and what they know about the environment, pollution, and economics, plan a community of 5,000 people using the symbols given at the bottom of the page to indicate the locations for the features they represent (add additional symbols if desired to add additional features)
(2) determine if they would have planned this the same way if there were a larger city five miles downstream connected by the same highway
(3) compare their home community with the ones planned by classmates and determine the necessity for a change in their home community

2. Select an area of unused land about one or two kilometers square which is adjacent to an expanding urban area (city or town). Secure topographic maps of the area for study by students.

a. Have students form teams to determine:

(1) the population of the urban area
(2) the demands on housing, jobs, transportation, and public utilities
(3) the vegetation of the area
(4) the economy of the area
(5) location of shopping areas
(6) educational needs
(7) zoning regulations

b. Have students suggest possible uses of the land if it were to be purchased by the urban area and classify these suggestions into several broad areas.

c. Following the previous activity have students select an area they wish to represent, form teams and prepare a case for presenting their desires about the use of the land to the planning commission and the city, town, or county council or board of supervisors.
d. Select a council and a planning commission to hear the cases. Have students carry out all presentations at the council hearing and then ask the council to vote on the issue. Be sure that all major categories are presented to the council. Determine if the majority of the students agree with their council's decision.
e. Have students analyze the presentation of their cases to determine if they could have built a stronger case for their planned use of the area.
f. Have students compare the outcome of this organized planning for land use with what is taking place in their community.

# APPENDIX

## READINGS IN ENVIRONMENTAL EDUCATION

In recent years an avalanche of environmental literature has developed which poses special problems for the teacher. The sheer numbers of publications make it extremely difficult for teachers to become aware of and judge the value of such publications in their programs. Because of the general lack of agreement as to what constitutes environmental education, sorting the relevant from the tangential and irrelevant is an overwhelming task. The references cited below represent an extremely small sample of the potentially valuable literature that might be used in environmental education programs in the schools. Each has been selected because it supports, in one way or another, the philosophy and objectives employed in the development of this guide. Brief annotations are provided to characterize the reference and to suggest ways in which it might be employed by teachers and/or students in creating locally-developed environmental investigations.

Allen, Rodney F., Carmelo P. Foti, Daniel M. Ulrich, and Steven H. Woolard. 1973.

*Deciding How to Live on Spaceship Earth: The Ethics of Environmental Concern*
Winona, Minnesota, Plover Books, 133 pp. (Paperback)

After an introductory chapter in which a series of hypothetical dilemmas are used to raise questions about solving value-based ethical problems, and suggestions for decision-making are made, the book proceeds through seven "Environmental Encounters". In each encounter, information is provided, simulations and role-playing suggestions are made, and "Sensitivity Modules" are provided. The final chapter raises questions about the future of "Spaceship Earth". This is an excellent source of guidance in raising ethical aspects of locally-developed environmental investigations.

Andrews, William A., Donna K. Moore, and Alex C. LeRoy, 1972.

*A Guide to the Study of Environmental Pollution* (A title in the series: *Contours: Studies of the Environment*)
Englewood Cliffs, N. J., Prentice-Hall, Inc. 260 pp. (Paperback)

This book deals with air and water pollution. In addition to discussions of ecological principles underlying pollution problems, the extensive use of air and water quality data from locations in the U. S., Canada, and elsewhere enhance the credibility of the text. Chapters 6 and 7 provide a useful account of field and laboratory study strategies and methods of examining air and water quality. The final chapter consists of case studies composed of data collected from various locations in North America. The book could be very useful in providing students with information and methods for studying the "science dimension" of local environmental investigations in which air and water quality are principle concerns.

Andrews, William A., Daniel G. Stoker, Donna K. Moore, Larry N. Deble and Elaine C. McKnight, 1974.

*A Guide to the Study of Terrestrial Ecology* (A title in the series: *Contours: Studies of the Environment*)
Englewood Cliffs, N. J., Prentice-Hall, Inc., 246 pp. (Paperback)

This book deals with the interrelationships of living things and their environment and centers around forest, woodlot, meadow, park, bog, and sand dune ecosystems. After an introduction to the basic principles involved in an ecosystem the editor provides the reader with evidence of the major types of biomes in North America and their distribution.

Chapters three and four provide the reader with numerous activities for abiotic and biotic field and laboratory studies. Chapter five introduces the reader to four areas for major field studies, provides direction for such studies, and is followed by suggested research topics. Chapter seven presents actual case studies relative to pest control, succession, and endangered species.

The book provides the teacher or student with the background knowledge and procedures required to make investigations in the field and the laboratory.

Brehman, Thomas R. 1973

*Environmental Demonstrations, Experiments and Projects for the Secondary School,* West Nyack, N. Y., Parker Publishing Company, Inc. 213 pp.

After introducing the book with a chapter on environmental principles, the author provides a variety of student activities and teacher demonstrations, together with detailed methods necessary for presentation of environmental studies. Suggestions lean more heavily on ecological emphases than on social and cultural aspects, but the information provided and methods suggested can be helpful to the teacher in developing local investigations.

Caldwell, Lynton K.

*Environment: A Challenge to Modern Society,* 1971, Garden City, New York, Doubleday and Co., Inc. 301 pp. (paperback)

The author has devoted many years in studying the interactions of science, technology, and public policy as they affect present-day society. He views environmental problems as a social scientist, traces the historical bases for our attitudes toward the environment, and explains the new attitudes needed for effective coping with our environmental problems. He views the ecological crisis as a major concern of public policy and suggests how public policy might function. For secondary and college students. An excellent background for students in discussing effective decision-making.

Davies, Nancy D., Daniel G. Stoker, Douglas E. Windsor, M. Terry Ashcroft, M. Carolynn Coburn, and William A. Andrews, 1973

*A Guide to the Study of Soil Ecology* (A title in the series: *Contours: Studies of the Environment*) Englewood Cliffs, N. J., Prentice-Hall, Inc., 198 pp. (Paperback)

This is a book of soil ecology. An opening chapter deals with a characterization of the soil ecosystem and is followed with detailed examinations of the origin and nature of soil and soil macrofauna and microorganisms. Chapter 5 consists of 43 field and laboratory studies of soil characteristics and conditions. Another chapter deals with soil research topics and the final chapter consists of case studies composed of data collected at a variety of unidentified locations. The book could be useful in providing students with information and methods for studying the "science dimension" of local environmental investigations in which soil characteristics are a principle concern.

Denver Public Schools, 1972

*Denver Urban Environmental Studies for Grades K through 6, Denver, Colorado.* Denver Public Schools, Division of Business Services, 68 pp.

This looseleaf booklet opens with a section describing the philosophy of the program. Two additional sections, one on the earth-home relationship and the other dealing with man, comprise the body of the book. A final appendix includes resources, a bibliography, and brief suggestions for taking an excursion. The book may provide suggestions to elementary teachers for identifying environmental subjects and means for studying them. Throughout, the emphasis is on studying the child's "real" environment in person.

Disch, Robert

*The Ecological Conscience: Values for Survival,* 1970, Englewood Cliffs, N. J., Prentice-Hall Inc. 206 pp. (Paperback)

The editor has compiled several articles under the headings of Ecological Crisis, Ecological Conscience, Impact of Ecological Values, and Cosmic Consciousness, to reinforce his point that talk and

good intentions will get you nowhere unless ecological values are integrated within all technological, scientific, economic, and political activities. He contends that unless our industrialized society adapts this attitude and approach our efforts are bound to collapse with a resulting "ecological suicide." For the secondary and college student. Provides reinforcement for the student in discussing public attitude in decision-making.

Geraghty, James J., *et al.* 1973

*Water Atlas of the United States*
Port Washington, N. Y., The Water Information Center, Inc.

The book consists of 122 full-page maps of the United States, each depicting information related to water availability and use patterns. Facing pages provide explanations for each map. Information mapped includes: physiography, distribution of precipitation, air temperature distribution, ground-water use, hardness of surface water, potential water pollution, and distribution of population. This book is an excellent source of information for developing national environmental investigations. Converting a number of the maps to the form of transparencies would provide an effective means of studying relationships which would be revealed through the use of overlays.

Goldman, Marshall I.,

*Controlling Pollution. The Economics of a Cleaner America*, 1967. One of Modern Economic Issues; Englewood Cliffs, New Jersey, Prentice-Hall, Inc. 175 pp. (Paperback)

The editor, an economist, through a collection of articles related to pollution, looks at the results of the divergence of social and private benefits from social and private costs or what he terms diseconomies. He states that the destruction of natural resources occurs primarily because of the difficulty of imposing monetary penalty on the polluter. He indicates the need for combining political, social, economic, and scientific forces to cope with an increasing dangerous situation. For secondary and college students. Provides the student with another view of the complexity in dealing with environmental issues.

Goldstein, Eleanor (Ed.). 1972

*Population* (Social Issues Resource Series)
Washington, D. C., Exotech Systems, Inc.

A collection of articles gathered from newspapers, magazines, journals, and government publications which represent a spectrum of opinion, emphasis, and complexity relative to population as an important social issue. This is a useful resource for the development of an informed basis in student discussion and debate.

Goldstein, Eleanor C. (Ed.) 1972

*Pollution* (Social Issues Resource Series)
Washington, D. C., Exotech Systems, Inc.

A collection of articles gathered from newspapers, magazines, journals, and government publications which represent a spectrum of opinion, emphasis, and complexity relative to pollution as an important social issue. It is a useful resource for the development of an informed basis in student discussion and debate.

Hill, Gladwin 1973

*Madman in a Lifeboat: Issues of the Environmental Crisis* (The New York Times Survey Series) New York, The John Day Company. 118 pp. (Paperback)

A brief, cynical, and argumentative survey of environmental issues. In addition to brief treatments of population, pollution, and resource management issues, it includes sections on the government's role, international implications, and citizen action. This inexpensive book could be useful in generating student debates over important issues and might be most useful as a stimulus for gathering information which could be used to refute positions taken by the author.

Kormondy, Edward J. 1969

*Concepts of Ecology* (A title in the series, *Concepts of Modern Biology*), Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 208 pp. (Paperback)

The author's unifying theme is the structure and function of ecosystems with reference to energy flow, nutrient cycling, population growth and regulation, and community organization and dynamics.

Designed for the general reader, and descriptions are presented in an interesting manner, stressing theory and observation rather than the mathematics.

Love, Glen A. and Rhoda M.

*Ecological Crisis: Readings for Survival*, 1970, New York, Harcourt, Brace, Jovanovich, Inc., 342 pp. (Paperback)

Because of the strong feelings of the editors, they have compiled outstanding selections of writers from the social scientists as well as the professional scientists and public officials. The editors' viewpoint depicts environmental problems as belonging to general education and the responsibility of social science, humanities, and the natural sciences.

The intent of the book is to provoke discussion and action toward an enhanced quality of life for all people on the earth. Intended for upper secondary and college students. Excellent background for student preparing for a discussion group.

McHale, John

*The Future of the Future*, 1971, New York, Ballantine Books, Inc. 370 pp. (Paperback)

The author surveys man's predicament in which a growing crisis in human development begins to affect the whole balance of global ecology and points out that we must become the master of the new technology in order to make the machine serve man's humanistic ends, and preserve and protect the life of our small crowded planet. For advanced secondary and college student. Supportive evidence for the student assuming the role of the humanist.

Mishan, E. J.

*Technology and Growth: The Price We Pay*, 1971, New York, Praeger Publishers, 193 pp. (Paperback)

The author expresses his concern for the effects of technology on society and human values. Through a factual and documentary approach he defends his viewpoint that any evaluation of technological advances should consider the destruction to natural resources, the dehumanization of daily life, and the mounting tide of frustration and violence associated with our society as a whole. He points out the necessity of government and the public dealing intelligently and critically with the possibilities and the limitations of technology in implementing human satisfaction. Intended for the advanced secondary and college student. Another good reference supporting the humanist point of view.

Myers, Charles B.

*The Environmental Crisis* (one of *Inquiry Into Crucial American Problems* series) 1972, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 119 pp. (Paperback)

Centered around student relevancy this author presents an in-depth study by reviewing a number of divergent viewpoints from a wide variety of different kinds of sources without endorsing any one viewpoint as being the right viewpoint. Discussion and reflection are encouraged through a number of questions without drawing any conclusions. Excellent for leading student into establishing a point of view. For secondary and college student.

National Audubon Society, 1970

*A Place to Live*, National Audubon Society, New York, Student Book, 64 pp., Teacher's Manual, 52 pp.

This set of materials was developed to provide a program in urban ecology for schools in New York City. The body of the student's book deals mostly with indoor activities related to the urban environment. Guide sheets to accompany ten environmental walks are provided. The teacher's guide provides considerable background information and suggestions. A table on the inside back cover of the teacher's guide identifies six environmental problems and suggests causes, consequences, possible solutions, and includes a section entitled "How You Can Help." The book might prove helpful to those elementary teachers whose schools are located in urban areas.

Nobile, Philip, and John Deedy (Eds.) 1972

*The Complete Ecology Fact Book*
Garden City, N. Y., Doubleday Anchor Books. 472 pp. (Paperback)

By no means complete, this book does contain many useful facts relating to population, endangered species, pollution, detergents, food supplies, pesticides, non-renewable mineral wastes, and solid wastes. An appendix contains brief accounts of recent court decisions involving environmental issues. The book could be useful to students as a source for certain types of data which would be valuable in developing local environmental investigations.

Odum, Eugene P.

*Fundamentals of Ecology*, third edition 1971, Philadelphia, Penna., W. B. Saunders Company, 574 pp.

The author approaches ecology as the whole environmental house in which we live or the totality of man and environment. He envisions three uses of the book, as follows: (1) Book One provides microscopic ecology as it relates to human affairs: Chapters 1 through 4 and 9, 15, 16, and 21 provide a review of ecology for the concerned citizen, the student of the social sciences, the humanities, the professions; and the specialist in science, government and industry; or for a reference base in human ecology. (2) Book Two, consisting of Chapters 1 through 10, Part 1, and Chapters 15, 16, and 21 with Part 2 and other chapters from Part 3 as references, would provide the undergraduate course in ecology. (3) Book Three, consisting of the entire book, provides a comprehensive reference work on principles, environments, and ecological technology. For the advanced secondary and college student.

Oliver, Ruth Norton (Ed.). 1971

*Museums and the Environment: A Handbook for Education*, New York, Arkville Press. 261 pp.

Consisting of contributions from a distinguished committee of the American Association of Museums, the book is a reference for all who wish to mount exhibits or initiate educational projects which

use museum resources and methods. The first three chapters deal with man and the environment, population, and environmental pollution. Each, after an opening background section, describes exhibits and projects related to the chapter title. Subsequent chapters deal with creating and building environmental exhibits, the use of films, the emerging role of museums in environmental education, and programs of action. While the other chapters may be of interest, the chapter in this book dealing with the creation and construction of environmental exhibits could be very useful in communicating the findings of student investigations to other students, the school, and the community. Not incidentally, such exhibits could also serve to evaluate the influence of investigations on student thinking.

Parson, Ruben L., et al

*Conserving American Resources*, third edition, 1972, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 608 pp.

The author delves into a modern concept of resource management where resource management shifts from scientific theory toward social application. It is obvious from his approach that modern man cannot live in his environment without manipulating it and creating unnatural ecosystems.

One progresses from the idea of conservation through population and resource management in the United States. Following conservation designs on the land the author branches out to descriptions of the various resources and the management of each, culminating with environmental quality as a function of the sum of all the external forces of the environment.

Piel, E. J., and J. G. Traux, 1973

*Man and His Technology: Problems and Issues*, New York, McGraw-Hill Book Company. 261 pp. (Paperback)

The book evolved in relation to the Engineering Concepts Curriculum Project's textbook, *The Man-made World*. The book takes a look at a number of socio-technical problems in contemporary society. Discussions and analyses of problems related to population, delivery of health services, emergencies, decisions, the energy crisis, and noise environment comprise the body of the book. A final section poses 24 problems which are related to those developed more fully in earlier chapters. The book is an excellent source of ideas and recommendations for approaches to the development of environmental investigations in the localities.

Platt, Rutherford

*The Great American Forest*, 1971, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 271 pp. (Paperback)

An historical approach to the forest and its relationship to the human race. It is concerned with the various aspects of one-third of the United States. The author describes what forests are, how they live and develop, the locations of the different kinds of forests, their functions and what the human race has done to them. He emphasizes the importance of the forest to the human race and identifies the part man plays in threatening the continued existence of the forest which is essential to man. Intended for the secondary level. Excellent background reading for student in preparing for discussion group.

Sale, Larry L. and Ernest W. Lee. 1972

*Environmental Education in the Elementary School*, New York, Holt, Rinehart and Winston. 203 pp. (Paperback)

The book opens with a section which describes environmental problems and issues, suggests what the elementary teacher should know about ecology, identifies learner characteristics upon which pro-

grams should be based, and makes some suggestions regarding environmental education curriculum design. Subsequent sections provide background on environmental problems and practical ideas and techniques for teachers. The book may be helpful to elementary teachers by revealing some likely components to build into a locally-developed program along with some suggestions for implementation.

Schlichting, Harold E., Jr., and Mary Southworth, 1971

*Ecology: The Study of Environment*, Austin, Texas, Steck-Vaughn Co., 48 pp.

An elementary introduction to interrelationships of man, plants, and animals. Clear explanations, diagrams, and drawings are used to introduce the ideas of food chains, web of life, ecosystems, and biomes. An interesting reference for the middle elementary student or the student above this level but reading on a lower level.

Stoker, Daniel G., Marcel Agsteribbe, Nancy R. Windsor, and William A. Andrews, 1972

*A Guide to the Study of Freshwater Ecology* (A title in the series: *Contours: Studies of the Environment*), Englewood Cliffs, N. J., Prentice-Hall, Inc., 182 pp. (Paperback)

After an opening chapter dealing with basic principles, succeeding chapters deal with ecological considerations of lakes, ponds, rivers, and streams. Thirty field and laboratory studies are described in Chapter 5. Materials, equipment, and techniques for extensive field studies are described in the following chapter and the final chapter consists of case studies composed of actual data gathered from different locations around the world. The book could be very useful in providing students with information and methods for studying the "science dimension" of local environmental investigations in which bodies of fresh water are a principle concern.

Terry, Mark, 1971

*Teaching for Survival*, New York, Friends of the Earth, Ballantine Books, 213 pp. (Paperback)

The author observes that teachers and schools have been portraying environmental concepts for years through their policies and procedures. To overcome the limited and misleading effects of these past efforts, he advocates alternative ways of operating in the classroom, school, and community. This is an important book and should be read by all teachers considering the introduction of environmental education programs in their schools.

United States Environmental Protection Agency, 1973

*Action for Environmental Quality: Standards and Enforcement for Air and Water Pollution Control*, Washington, D. C., U. S. Government Printing Office (Stock No. 5500-00087)

This book describes the process of developing criteria, setting standards, and means of enforcement for air and water pollution control. It is particularly useful in raising questions about the role of governmental agencies in environmental management, problems of law enforcement, and the relationship between the individual, his community, and government agencies.

Van Matre, Steve, 1972

*Acclimatization: A Sensory and Conceptual Approach to Ecological Involvement*, Martinsville, Indiana, American Camping Association, 138 pp. (Paperback)

The author describes a camping education program developed at Towering Pines Camp in Eagle River, Wisconsin. After criticizing traditional camping programs, he proceeds to recommend an approach which promotes extensive sensory involvement in outdoor activities. Although there is a strong natural history emphasis in this book, the rationale and commentary on extensive sensory involvement by the learner may have important applications in locally developed environmental encounters.

Watt, Kenneth E. F.

*Principles of Environmental Science*, 1973; New York, McGraw-Hill Book Company, 319 pp.

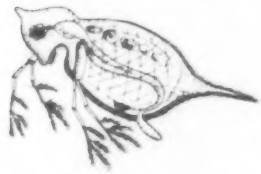
The author has a modern approach to a broader field of ecology referred to as environmental science. Through such disciplines as urban and regional planning, economic geography, epidemiology, community medicine, meteorology, agriculture, forestry, fisheries, and range management the book delves into the underlying core of principles to which all aspects of environmental science can contribute. The book places emphasis in ecology on the processes in terms of the efficiency of energy transfer systems. It is intended for the college freshman or the advanced secondary student. Excellent reference for the student wishing to pursue greater depth in the study of environmental ecology.

# SUB-SURFACE FRESH WATER ORGANISMS

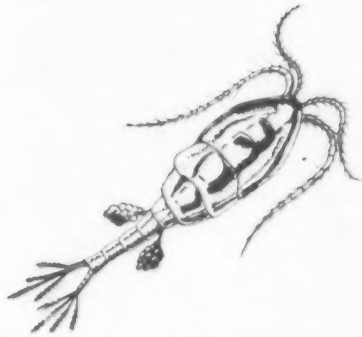
1. PLANARIA
1.27 - 2.54 cm

2. BRYOZOAN COLONY

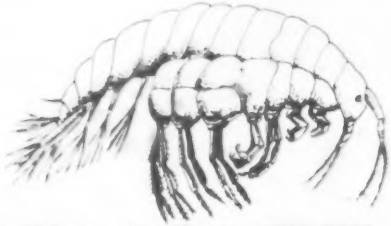
3. LEECH 1.27 - 5.08 cm.



4. DAPHNIA 1.6 mm



5. CYCLOPS 2.54 mm



6. FRESH WATER SHRIMP
2.54 cm

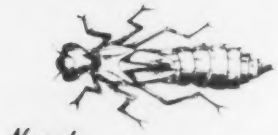
7. FAIRY SHRIMP
2.54 cm



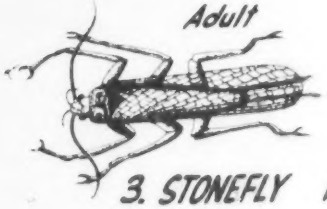
Courtest of
Virginia Commission of Game
and Inland Fisheries

# AQUATIC INSECTS

1. MAYFLY 2.79cm



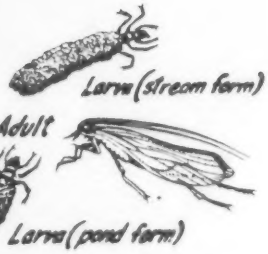
2. DRAGONFLY 5.08-7.62 cm



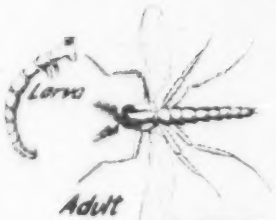

3. STONEFLY 1.79cm

4. WATER BOATMAN 1.02 cm

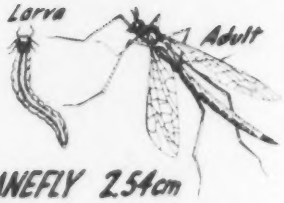
5. WATER STRIDER 1.02cm




6. CADDIS FLY 2.29cm




8. MIDGE 2.54-12.7mm




9. CRANEFLY 2.54cm

7. WHIRLIGIG BEETLE 1.52cm

10. MOSQUITO 7.62mm

11. BLACK FLY 1.27cm

Courtesy of
Virginia Commission of Game
and Inland Fisheries